The Electrical World.

VOL. XXVII. NEW YORK, MAY 9, 1896. No. 19.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. *Cable Address: "Electrical," New York*

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the United States, Canada or Mexico; other foreign countries, $6

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVII. NEW YORK, MAY 9, 1896. No. 19.

CONTENTS.

Editorial 505
On a New Form of Radiation, by Prof. W. K. Röntgen 507
On the Reflection of Röntgen Rays, by Prof. O. N. Rood 508
On the Polarization of Röntgen Rays and on the Formulæ of Transmission of These Rays, by Prof. Alfred M. Mayer 508
Relative Permeability of Magnesium and Aluminum to the Röntgen Rays, by Prof. A. W. Wright 509
An Instrument for Directly Measuring the Mean Spherical Candle-Power of Arc Lamps and Other Luminous Sources, by E. J. Houston and A. E. Kennelly 509
A History of Electric Lighting, by Prof. F. B. Crocker 511
National Electric Light Association 513
Since the Last National Electric Light Convention 516
President Wilmerding 516
A Few Suggestions for Convention Visitors 517
At the Exposition 519
Are Röntgen Rays Induced Currents? by F. L. Woodward 522
How to Use a Voltmeter as an Ammeter, by A. O. Benecke 522
Reply to Mr. Benecke, by George T. Hanchett 522
Digest of Current Electrical Literature, compiled by Carl Hering 523
New Book 528
Automatic Motor Starter 528
New Long-Burning Arc Lamp 528
A New Lathe 529
Electric Locomotive 529
A New Gas Engine for Electric Lighting 529
Warren Inductor Alternator 530
Jenney Multipolar Dynamo 530
Jack-Knife Switches 530
The Magnetic Blow-Out Lightning Arrester 531
Electric Vulcanizer 531
New Incandescent Lamp Company 532
The Folsom-Sacramento Power Transmission Plant 532
"Hub" Anti-Friction Ball Bearings 534
Feed-Water Heater and Purifier 534
Electric Exhaust Ventilating Wheel 535
Automatic Safety Hanger 535
Improved Arc Cut-Out 535
The Manhattan Enclosed Arc Lamp 535
Some New Specialties 536
The Lippincott Planimeter 536
DEPARTMENTS:
Financial Intelligence 537
Special Correspondence 537
General News of the Week 540
Trade and Industrial Notes 542
Business Notices 543
Illustrated Record of Electrical Patents 543

GREETING TO OUR VISITORS.

For the third time the National Electric Light Association will, during the present week, meet in New York City, under auspices of the most favorable character. At any time and at all times the metropolis of America is a pleasant place to visit, but at this season of the year, when Nature is in her best mood, there is an irresistible fascination about the city and vicinity, not only to strangers but to the citizens themselves. The smokeless and pure atmosphere for which New York is justly renowned is more brilliant and exhilarating in the month of May than at any other time of the year; the verdure in the parks and on the boulevards and private lawns is more beautiful and fresher than any other season, and on every hand there is evidence of new life, happiness and energy. No city in America can feel so justly proud of her institutions, and doubtless none can offer more opportunities for amusement, has so many points of interest or can excel in its educational advantages. We feel sure that our visitors will enjoy their stay, and we extend to all a hearty greeting.

THE CONVENTION AND EXPOSITION.

The programme of the convention provides some valuable papers, and it is interesting to compare the character of the papers read at the more recent conventions, including those to be read this week, with those presented at the earlier meetings. Those of the present day are based on practical experience and patient research and study, and offer to the members valuable suggestions, whereas in the earlier days everybody was groping around in the dark, and authors of papers rarely had anything of a very definite character to say. Practical experience in the new-born industry was, at that time, a decidedly minimum quantity, but the push and energy of the electric light men has finally resulted in marked changes in this respect. By hard work and close attention to details, the electric light business has grown from practically nothing to be one of the most important industries of modern times, and in the comparatively short space of fifteen years. This wonderful record has been achieved largely by the men who will meet in convention this week to exchange views, and learn what they can from each other on matters of mutual interest; they will discuss the hard knotty problems encountered in their everyday work, and find the easiest way out of their difficulties. Probably the most obdurate and unyielding obstacle they have to contend with is the difficulty of keeping a margin of safety between their income and expense accounts. In many cases the fond hopes and hard-earned dollars of investors are consumed in the furnace fires, and it is a struggle to keep both sides of the ledger accounts in satisfactory relations with one another. The Electric Light Association has helped many struggling concerns out of difficulties of this nature, and turned adversity into prosperity. The association is one primarily for mutual benefit, and that it fulfills the object of its existence is evidenced by the large attendance at its meetings, and the enthusiastic participation of the members in the proceedings. In tracing the history of the association from the time of its birth to the present day, the record is one of increasing strength and influence, and now the organization occupies a high rank among the list of semi-scientific bodies. It is composed principally of practical business men, but it takes on a semi-scientific aspect for the reason that its members have been compelled to fight their own battles with technical problems, and in this way they have become experienced with the technical side of their profession as well as with its business requirements. The standard of technical

knowledge is gradually but continually rising, and it is in such meetings as the present that the greatest opportunities are offered for becoming more thoroughly acquainted with the best practice. The list of papers to be presented shows that the association recognizes the broad field which they are gradually covering. The first business of the convention, the report of the Committee on Rules for Safe Wiring, will be received with considerable interest, inasmuch as it has for its ostensible object the presentation of a consensus of opinions expressed by committees representing various interests, and it is to be hoped that the report will lead to some definite result in the way of settling at least a few of the questions now distressing the profession. It is scarcely more than a year since the acetylene gas scare presented itself, and after waiting for this period for some decisive statements in regard to its cost of production, it is to be hoped that Mr. Ferguson will enlighten us on this as well as other prominent features which have been attributed to this product. The desirability of having a standard socket can scarcely be questioned, but the process of putting such practice into vogue is likely to meet not only with considerable opposition but would necessarily be extended over a long and indefinite period, unless it could be concurred in by the lamp manufacturers that after a certain time only lamps having the standard base would be supplied, an agreement, however, difficult of consummation. The discussion on this question is timely, and it is to be hoped will prove fruitful in its results. In regard to the Exposition, which is a concurrent event with the convention, we are sorry to observe that the managers are apparently prepared, judging from the title which they have attached to the enterprise, to make any sacrifice, if by doing so they may achieve ultimate success. Doubtless, however, their business experience and sagacity have directed their thoughts, and they have foreseen the advantages to be gained by adopting a term already familiar to the public, and thoroughly advertised in connection with enterprises of the horse, dog and baby variety. An electrical exposition can, however, scarcely be classified under this category, and it is to be regretted that they have deemed it advisable to take advantage of the opportunity thus presented, since by doing so they have sacrificed a very important factor, which is dignity. In other respects much credit is due to the projectors of this extensive undertaking. Hitherto the exhibitions of electrical apparatus and supplies at conventions have been subordinate in their importance with reference to the occasion of their existence, but in the present instance the usual conditions are apparently reversed. The Electrical Exposition has evidently far exceeded in size and importance the estimates put upon it by its promoters, and it is unnecessary to say that their work will receive the approbation of the electrical fraternity, and we trust that at the same time the general public will show its appreciation of the efforts put forth largely in its behalf in order to demonstrate the wonders of electricity.

RÖNTGEN RAYS.

We print elsewhere in the columns of this issue several articles on Röntgen rays, including one which will doubtless prove of special interest, being the second of Prof. Röntgen's communications. This second paper is as noteworthy in its clear and concise statements as its predecessor, and considering the time at which it was written, together with more recent developments, it demonstrates that Prof. Röntgen at this time was fully maintaining his advantageous lead. Although most of the contents of the paper are more or less familiar, t, however, contains features worthy of considerable study and which will doubtless open up a still more extended field of research. Contrary to the results of others, Prof. Röntgen fails to find any material difference in the rate of discharge of different electrified bodies, no matter whether they are positively or negatively charged. Perhaps the most interesting part of the communication is the description of the method which he employs in order to show that air, when subjected to the action of the rays, retains for some time after the action of the tube has ceased the property of dissipating an electrical charge. In this property doubtless lies the explanation for some of the observed phenomena in which Röntgen rays appeared to be in their action analogous to sound waves and at the same time is in accord with, if not an explanation for, the results obtained by Dr. Pupin, Prof. Thomson and others, indicating a remarkable diffusing power in the air, the latter in turn being capable of acting as a secondary source of radiance. It would seem probable that dry air itself, when not in motion, could in no way dissipate this peculiar property. Prof. Röntgen does not state that he has attempted to find this same property in other gases, but has found that in dry hydrogen as well as in highly exhausted vessels electrified bodies are discharged when subjected to the action of the rays. In regard to the source of the rays Prof. Röntgen's statements are in accord with those now generally accepted. The paper read before the last meeting of the National Academy of Science by Prof. Rood, inasmuch as it was accepted without criticism by the members present, is to be looked upon as one of the most important additions made to the literature of this subject. The paper read by Prof. Mayer before the same meeting, owing to its concise and accurate treatment, is to be accepted as conclusive in so far as it applies to the non-polarization of the Röntgen rays when passing through herapathite and tourmaline, although at variance with results obtained by Galitzine and Karnajitzky as expressed in their Academy paper, abstracted in *L'Industrie Electrique*, April 10. By using three plates of tourmaline placed above the sensitive plate and with their axes crossed, they found that when subjected to the action of the Röntgen rays the effect was less than with the axes parallel, thus inferring that Röntgen rays consist of transverse and not longitudinal vibrations. Prof. Mayer found, that no screening action could be detected either with the axes parallel or crossed. He also expresses the formula for the transmission of homogeneous Röntgen rays through non-reflecting substances in the simple exponential form, and according to Prof. Wright the ratio of the exponential forms of two different substances expresses the relative permeability of these substances. Owing to the fact, however, that Röntgen rays are most likely not entirely homogeneous, the simple experimental form is not the correct and most complete expression. Prof. Wright, however, at the same time, observes that the relative permeability of metals follows the general law of increasing more rapidly than the density decreases. Prof. Röntgen has set a new problem before investigators, and the results of their labors will be looked forward to with a great deal of interest.

American Motors Preferred.

In a recent paper by Mr. Daniel Adamson, before the Manchester Association of Engineers, on the electrical driving of machinery, he stated, in referring to his own works, that they wanted a motor to drive their boiler shell drill and had to obtain it from America, "being unable to buy one here [England] at a reasonable price." The motor had to be run in either direction and at two speeds in one of these, all to be controlled by one handle.

Röntgen Rays Considered as Light Phenomena.

We notice that the large number of abstracts which are contained in the April number of the *Proceedings* of the Physical Society of London, are classified under the general heading of "light" and not under "electricity." If this was done at the suggestion or with the consent of any number of the officers of the society, the list of which includes many of the most prominent English physicists, it might be taken as an interesting prophecy.

On a New Form of Radiation.*

BY PROF. WILHELM KONRAD RÖNTGEN.

As my investigations will have to be interrupted for several weeks, I propose in the following paper to communicate a few new results.

Sec. 18. At the time of my first communication it was known to me that X-rays were able to discharge electrified bodies, and I suspected that it was X-rays, not the unaltered cathode rays which got through his aluminum window, that Lenard had to do with in connection with distant electrified bodies. When I published my researches, however, I decided to wait until I could communicate unexceptional results. Such are only unobtainable when one makes the observation in a space which is not only completely protected against the electrostatic influences of the vacuum tube, leading-in wires, induction-coil, etc., but which is also protected against the air coming from the vicinity of the discharge apparatus. To this end I made a box of soldered sheet zinc, large enough to receive me and the necessary apparatus, and which, even to an opening which could be closed by a zinc door, was quite air-tight. The wall opposite the door was almost covered with lead. Near one of the discharge apparatus placed outside the lead-covered zinc wall was provided with a slot 4 centimetres wide, and the opening was then hermetically closed with a thin aluminum sheet. Through this window the X rays could come into the observation-box. I have observed the following phenomena:

(*a*) Positively or negatively electrified bodies in air are discharged when placed in the path of the X-rays, and the more quickly the more powerful the rays. The intensity of the rays were estimated by their effect on a fluorescent screen or on a photographic plate. It is all the same whether the electrified bodies are conductors or insulators. Up to the present I have discovered no specific difference in the behavior of different bodies with regard to the rate of dlscharge, and the same remark applies to the behavior of positive and negative electricity. Nevertheless, it is not impossible that small differences exist.

(*b*) If an electrical conductor is surrounded by a solid insulator, such as paraffin, instead of by air, the radiation acts as if the insulating envelope were swept by a flame connected to earth.

(*c*) If this insulating envelope is closely surrounded by a conductor connected to earth, which should, like the insulator, be transparent to X-rays, the radiation, with the means at my disposal, apparently no longer acts on the inner electrified conductor.

(*d*) The observations described in *a*, *b* and *c* tend to show that air traversed by X-rays possesses the property of discharging electrified bodies with which it comes in contact.

(*e*) If this be really the case, and if, further, the air retains this property for some time after the X-rays have been extinguished, it must be possible to discharge electrified bodies by such air, although the bodies themselves are not in the path of the rays.

It is possible to convince one's self in various ways that this actually happens. I will describe one arrangement, perhaps not the simplest possible. I employed a brass tube, 3 cm in diameter and 45 cm long. A few centimetres from one end a portion of the tube was cut away and replaced by a thin sheet of aluminum. At the other end an insulated brass ball fastened to a metal rod was led into the tube through an air-tight gland. Between the ball and the closed end of the tube a side tube was soldered on, which could be placed in communication with an aspirator. When the aspirator was worked the brass ball was surrounded by air, which on its way through the tube went past the aluminum window. The distance from the window to the ball was over 20 cm. I arranged the tube in the zinc box in such a manner that the X-rays passed through the aluminum window at right angles to the axis of the tube, so that the insulated ball was beyond the reach of the rays in the shadow. The tube and the zinc box were connected together; the ball was connected to a Hankel electroscope. It was seen that a charge (positive or negative) communicated to the ball was not affected by the X-rays so long as the air in the tube was at rest, but that the charge immediately diminished considerably when the aspirator caused the air traversed by the rays to steam past the ball. If the ball by being connected to accumulators was kept at a constant potential, and if air which had been traversed by the rays was sucked through the tube, an electric current was started as if the ball had been connected with the wall of the tube by a bad conductor.

(*f*) It may be asked in what way the air loses this property communicated to it by the X-rays. Whether it loses it as time goes on, without coming into contact with other bodies, is still doubtful. It is quite certain, on the other hand, that a short disturbance of the air by a body of large surface, which need not be electrified, can render the air inoperative. If one pushes, for example, a sufficiently thick plug of cotton wool so far into the tube that the air which has been traversed by the rays must stream through the cotton wool before it reaches the ball, the charge of the ball remains unchanged when suction is commenced. If the plug is placed right in front of the aluminum window the result is the same as if there were no cotton wool, a proof that dust particles are not the cause of the observed discharge. Wire gauze acts in the same way as cotton wool, but the meshes must be very small, and several layers must be placed one over the other if we want the air to be active. If the nets are not connected to earth, as heretofore, but connected to a constant potential source of electricity, I have always observed what I expected; however, these investigations are not concluded.

(*g*) If the electrified bodies are placed in dry hydrogen instead of air they are equally well discharged. The discharge in hydrogen seems to me somewhat the slower. This observation is not, however, very reliable on account of the difficulty of securing equally powerful X-rays in successive experiments. The method of filling the apparatus with hydrogen precluded the possibility of the thin layer of air which clings to the surface of the bodies at the commencement playing an appreciable part in connection with the discharge.

(*h*) In highly-exhausted vessels the discharge of a body in the path of the X-rays takes place far slower—in one case it was, for instance, 70 times slower—than in the same vessels when filled with air or hydrogen at atmospheric pressure.

(*i*) Experiments on the behavior of a mixture of chlorine and hydrogen, when under the influence of the X-rays, have been commenced.

(*j*) Finally, I should like to mention that the results of the investigations on the discharging property of the X-rays, in which the influence of the surrounding gases was not taken into account, should be for the most part accepted with reserve.

Sec. 19. In many cases it is of advantage to put in circuit between the X-ray producer and the Ruhmkorff coil a Tesla condenser and transformer. This arrangement has the following advantages: Firstly, the discharge apparatus gets less hot, and there is less probability of its being pierced; secondly, the vacuum lasts longer; at least this was the case with my apparatus, and thirdly, the apparatus produces stronger X-rays. In apparatus which was either not sufficiently or too highly exhausted to allow the Ruhmkorff coil alone to work well, the use of a Tesla transformer was of great advantage.

The question now arises—and I may be permitted to mention it here, though I am at present not in a position to give an answer to it—whether it be possible to generate X-rays by means of a continuous discharge at a constant discharge potential, or whether oscillations of the potential are invariably necessary for their production.

Sec. 20. In Sec. 13 of my first communication it was stated that X-rays not only originate in glass, but also in aluminum. Continuing my researches in this direction I have found no solid bodies incapable of generating X-rays under the influence of cathode rays. I know of no reason why liquids and gases should not behave in the same way.

Quantitative differences in the behavior of different bodies have, however, revealed themselves. If, for example, we let the cathode rays fall on a plate, one half consisting of a 0.3 mm sheet of platinum and the other half of 1 mm sheet of aluminum, a pin-hole photograph of this double plate will show that the sheet of platinum emits a far greater number of X-rays than does the aluminum sheet, this remark applying in either case to the side upon which the cathode rays impinge. From the reverse side of the platinum, however, practically no X-rays are emitted, but from the reverse side of the aluminum a relatively large number are radiated. It i easy to construct an explanation of this observation, still it is to be recommended that before so doing we should learn a little more about the characteristics of X-rays.

It must be mentioned, however, that this fact has a practical bearing. Judging by my experiments up to now, platinum is the best for generating the most powerful X-rays. I used a few weeks ago, with excellent results, a discharge apparatus in which a concave mirror of aluminum acted as cathode and a sheet of platinum as anode, the platinum being at an angle of 45° to the axis of the mirror and at the centre of curvature.

Sec. 21. The X-rays in this apparatus start from the anode. I conclude from experiments with variously-shaped apparatus that as regards the intensity of the X-rays it is a matter of indifference

* From the London *Electrician*, April 24, 1896.

whether or no the spot at which these rays are generated be the anode. With a special view to researches with alternate currents from a Tesla transformer, a discharge apparatus is being made in which both electrodes are concave aluminum mirrors, their axes being at right angles; at the common centre of curvature there is a "cathode-ray catching" sheet of platinum. As to the utility of this apparatus I will report further at a later date.

Würzburg, Physikal. Institut. d. Universität. March 9, 1896.

On the Reflection of Röntgen Rays.*

A sheet of platinum foil, 7 inches square, reflected the rays to the plate holder, the angle being 45 degrees. Before reaching the sensitive plate the rays were obliged to traverse an aluminum plate having a thickness of 17 mm, the middle horizontal portion of the plate being protected by a second similar strip of aluminum. Over these shields was placed a wire netting with openings of one-eighth inch. In addition to the above, the plate was protected by a draw-slide that had proved perfectly impervious to the action of bright sunlight in an exposure lasting for two hours. The reflecting surface of platinum was necessarily so placed that *diffused* reflected light from it would have reached all portions of the plate. Fig. 1 is a sketch of the result produced; the image included eight of the wires, and then stopped short.

Fig. 2 was obtained in this way: The plate with image produced by reflection having been removed after an exposure of 10 hours, a second sensitive plate was substituted for it, and being covered only by the wire netting, was exposed in a dark room to one flash from

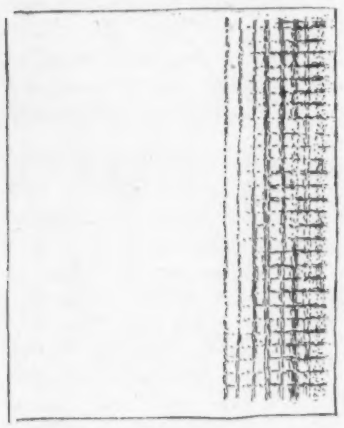


Fig. 1.

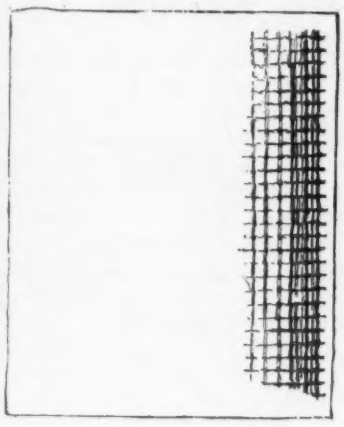


Fig. 2.

the inductorium. The illumination in Fig. 2 was due to ordinary light, which was, of course, regularly reflected, or underwent specular reflection from the polished platinum surface, but there is a close correspondence between the images on the two plates. The vertical lines in Fig. 2, owing to the irregularities in the platinum surface, are doubled in certain portions; in the corresponding places in Fig. 1 the vertical lines are indistinct; the *horizontal* lines in both plates are, on the other hand, well marked.

The only essential difference in the plates is that the one obtained by reflection included eight wires instead of six. This is accounted for by the fact that source of the Röntgen rays included a portion of the tube that furnished too little ordinary light to affect the sensitive plate during a single flash of the inductorium, as was illustrated by a drawing of the apparatus. The lower portion of the image in Fig. 2 is cut off in a slanting direction by the strip of wood used to confine the netting; this deformation does not appear in Fig. 1, the Röntgen rays having traversed the wood. The wood strip at the top of Fig. 2 has also cut off a small portion of the image of the netting.

The original negatives were presented by Prof. Rood for examination, and a lengthened study of them was made by Profs. Rowland and Mayer, who were decidedly of the opinion that they demonstrated the regular or specular reflection of the Röntgen rays. A negative taken by Prof. Rood with a second Crookes tube was also shown. According to Prof. Rood's determinations, about one two hundred and sixtieth part of the rays are reflected by polished platinum at an angle of incidence of 45 degrees.

Owing to the severe test to which Prof. Rood subjected his experiments, the negatives are not sufficiently strong to admit of reproduction. Figs. 1 and 2 have therefore been sketched from the originals and illustrate as well as can be expected the principal points referred to.

* Abstract of a paper read before the National Academy of Science, April 23, 1896, by Prof. O. N. Rood.

On the Polarization of Röntgen Rays and on the Formulæ of Transmission of These Rays.

Prof. Alfred M. Mayer's paper read before the last meeting of the National Academy of Sciences consisted of three parts, viz.: (1) On the fact that the Röntgen rays cannot be polarized by passing through such substances as herapathite and tourmaline. (2) On the density of herapathite. (3) On the formulæ of the transmission of the Röntgen rays through glass, green tourmaline and herapathite.

The substance peculiarly fitted to experiment on so as to settle the question whether the Röntgen rays can or cannot be polarized is herapathite; an iodosulphate of quinine discovered by Dr. Herapath in 1852. This substance has, in a remarkable degree, the two properties which Röntgen has pointed out as necessary in order that it shall be readily traversed by the rays which he discovered; viz., a low density of only 1.55, and an extreme thinness. Crystal plates of this substance, used by Prof. Mayer, had, on the average, a thickness of only one one-thousandth inch. If the optic axes of two of these plates are crossed at 90 degrees, the crossed portions of the crystals appear intensely black when viewed against a bright light; so powerful is the polarizing power of this substance on light. When the optic axes of two plates are placed parallel to one another, the combined plates freely transmit the incident light, the plates appearing of a very light olive green.

Many crystals of this herapathite were placed on six thin glass discs, one one-hundredth of an inch thick and one inch in diameter. Also, several layers of the crystals were placed on a piece of thick yellow blotting paper. On these discs and blotting paper the crystals crossed at various angles; where their axes crossed at a right angle the crossed portions appeared black. Now if the Röntgen rays be polarizable these black portions of the crystals should act like thick lead and entirely screen the photographic plate from the action of the Röntgen rays.

These glass discs and the blotting paper carrying the herapathites were cemented to the screen covering the photographic plate. This screen was impervious to two hours' exposure to the sun's light. Exposures to the Röntgen rays of one half hour, one hour and two hours were made. On developing these plates no trace whatever of the herapath crystals could be detected in the photographs. The crystals were so thin that they did not appreciably screen the Röntgen rays when the axes of two superposed crystals were parallel to one another, and when the axes of the crystals crossed at a right angle and were impervious to light there was just the same inappreciable screening effect. These experiments prove conclusively that the Röntgen rays cannot be polarized by passing through herapathite, by far the most powerful polarizing substance known.

The formulæ of transmission of the Röntgen rays through glass, tourmaline, and through herapathite, were determined as follows: Piles of glass discs, making a graded series of thickness of glass, were placed on a wire netting, with meshes one eighth inch wide. This netting (first used by Prof. Rood in his experiments) was attached to the draw-slide covering the photographic plate. Exposing to the action of the Röntgen rays, these rays, say in one hour, penetrate, or, rather, just do not *visibly* penetrate one of the piles of glass. This was known by the wire netting being *just* visible through the next thinner pile of glass, and not visible through the pile of next greater thickness. The piles of glass differed in thickness by two tenths of a millimetre.

Now the least perceptible difference in the illumination of two juxtaposed surfaces that can be detected by the eye is about one one-hundredth. Therefore, only one one-hundredth of the incident Röntgen rays passed through the thickness of glass in whose photograph the lines of the wire netting has just become invisible. The formula of transmission of rays which are not reflected by a substance they traverse is $I^1 = Ia^t$. In which I^1 is the intensity of the rays which have traversed the substance, I the intensity of the rays incident on the substance, a is a constant whose value depends on the nature of the substance, and t the exponent of a power of a, is the thickness of the substance traversed by the rays. The unit of t was taken as one tenth mm. From the nature of the experiment, $I^1 = Ia^t =$ one one-hundredth. As t is known, and the equation equals one one-hundredth, a is readily calculated.

In this manner the formulæ of transmission of the Röntgen rays through glass, green tourmaline, and through herapathite were determined. Of course, something is assumed in experiments on

rays well called X by Röntgen, and our Xs always exceed the number of our equations. Prof. Mayer assumes, in order to make any progress in such work, that the Röntgen rays are homogeneous in their nature. The formula holds good and requires no modification until some one shows that they are not homogeneous.

Prof. Mayer will publish detailed accounts of these experiments, and give the constants of the formulæ of transmission through glass, aluminum, platinum, green tourmaline and herapathite, in the June number of the *American Journal of Science.*

Relative Permeability of Magnesium and Aluminum to the Röntgen Rays.*

The small density of metallic magnesium would lead us to expect a correspondingly high degree of permeability for the Röntgen rays. Experiment confirms this expectation in a very striking manner. For the purpose of comparison, first a plane plate of magnesium 1.324 mm in thickness was formed. This was cut into two equal portions, between which, upon the photographic plate, was placed a wedge of aluminum 50 mm long, the thickness of which varied from 0.2 mm at the thin end to 2.75 mm at the other. Similarly the two halves of a plane plate of aluminum 0.53 mm thick were placed either side of a pile of seven strips of magnesium ribbon, each strip being shorter than the one beneath it, so as to expose to the rays seven gradations of thickness. The average thickness of the strips was 0.163 mm, and the seven together made up 1.144 mm. A cylinder of magnesium 10.3 mm in diameter lay near the other pieces upon the sensitive plate. Prints from the negative developed after exposure to the rays showed that the magnesium transmitted them with much the greater facility.

The true relation between the relative permeabilities of the two metals would be expressed by the ratio of two exponential functions, and the value of the ratio would vary with the thickness. For very thin plates it would approach unity, and continuously increase with the thickness. Inspection of the photograph shows that the seven strips transmitted very nearly the same amount as the aluminum plate 0.53 mm thick; that the magnesium plate 1.324 mm transmitted as much as the aluminum wedge at a point where it was 0.636 mm thick. Within these limits the magnesium plate would be a little more than twice as thick as the aluminum strip transmitting the rays to the same extent, or its permeability is a little more than twice that of aluminum. The magnesium cylinder let through very nearly the same amount as the thick end of the aluminum wedge, the thickness being somewhat more than three times that of the aluminum. These results show the great superiority of magnesium for experiments upon the Röntgen rays, as it is more than twice as permeable for thicknesses between 0.5 mm and 1.0 mm. Very thin plates would show a less favorable relation, but would still possess a marked advantage.

Prof. Elihu Thomson Before the Electric Potential Club.

The illustrated lecture on Röntgen rays, delivered before the Electric Potential Club on Wednesday evening, April 22, in Boston, by Prof. Elihu Thomson, was a fitting close to another and successful year of this organization. The occasion being Ladies' Night, a goodly number were present, and the remarks of the professor being in his usual happy vein captivated the ladies as completely as he impresses bodies composed of the sterner sex.

Among other things Prof. Thomson referred to the work of Crookes of some 20 or 25 years ago, and said that it would no doubt have been possible to have obtained Röntgen rays from the tubes then used; but instead their capabilities had lain dormant and unsuspected until Röntgen's discovery. While admitting that the exact nature of the rays was still involved in obscurity, they appeared in most respects to act as invisible light or transverse ether waves of very short length. He did not incline favorably toward the view that they consisted of projected matter, nor was the sound-wave theory a tenable explanation.

Receiver for the Colorado Midland Railway.

Judge Caldwell in the United States Circuit Court, St. Louis, Mo., recently ordered Receiver Ristine of the Colorado Midland Railway to comply with the contract made by the road with the employees of its telegraph department in regard to salaries. The telegraphers assert that the receiver refused to recognize the contract and cut down their wages, but the action of Judge Caldwell restores the old schedule.

* Abstract of a paper read before the National Academy of Science, April 23, 1896, by Prof. A. W. Wright.

An Instrument for Directly Measuring the Mean Spherical Candle-Power of Arc Lamps or Other Luminous Sources.

BY EDWIN J HOUSTON, PH.D., AND A. E. KENNELLY, SC.D.

As is well-known the actual measurement, either of the total quantity of light emitted by an arc lamp or its mean spherical candle-power, is so difficult and tedious an operation, that to-day arc lamps are rated by the electric activity they consume rather than by the luminous power they produce. To partly obviate this difficulty, the authors have devised an apparatus which is capable of giving direct measurements of the mean spherical candle-power of a luminous source.

The main source of light in a carbon voltaic arc is known to be the crater at the extremity of the positive carbon or electrode: consequently, the luminous intensity emitted is much greater in certain directions than in others. In order to measure either the mean spherical candle-power of an arc lamp, or the total quantity of light emitted, it is necessary to measure the luminous intensity in as many positions as possible in a given vertical plane through the arc. This is, of course, a tedious operation, since each measurement requires some little time. Moreover, this difficulty is still further enhanced by the fact that the position of the crater is constantly changing, so that while a series of measurements are being made, the distribution of light sensibly alters.

Let *A B C D*, Fig. 1, be an imaginary sphere surrounding a point source of light, such as is practically embodied in a voltaic arc situated at its centre. Then we may assume that the light emitted

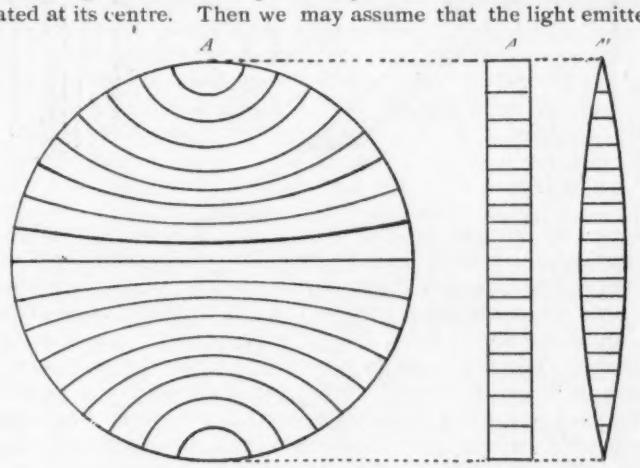


FIG. 1 AND 2.

by the arc is uniformly distributed around the sphere in longitude, but that the distribution varies in latitude, *A C* being the vertical polar axis of the sphere.

The total quantity of light emitted by the arc will depend upon the illumination of each band of latitude and on the circumference of each band.

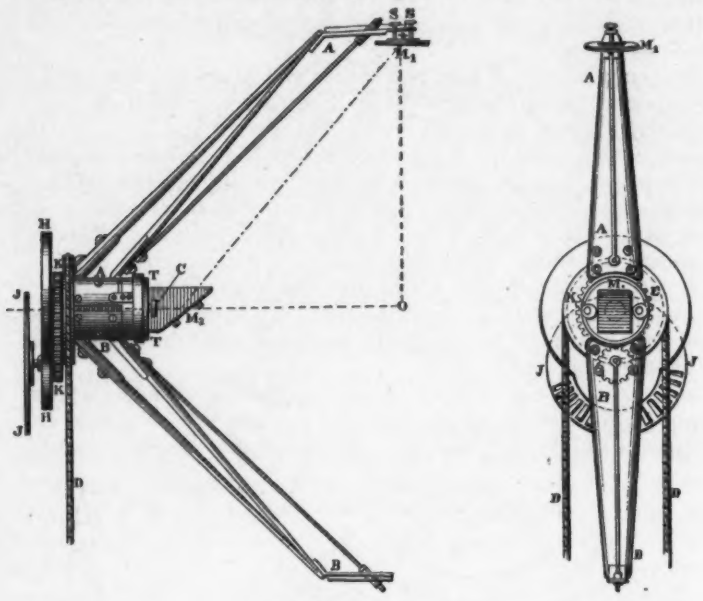
If we take a mirror and revolve it round any great circle in any vertical plane over the surface of the imaginary sphere, and reflect the light so received upon a photometer screen, the average illumination of the screen will not represent the mean spherical candle-power of the luminous source at the centre of the sphere, because each band of light will have the same influence upon the screen whether it is encountered near the poles or near the equator. Thus, if all the light of the arc were concentrated in a single band of latitude, the effect on the photometer with the revolving mirror would be the same whether the latitude of the band were 80° or at the equator itself; whereas, the total quantity of light emitted by the lamp would be much greater if supplied all around through a band at the equator, than all around through a band near the pole. If, however, the active surface of the mirror could be reduced at each point, as shown at *A'C'*, according to the breadth of the lune or spherical area included between two polar great circles, then the light reflected from the revolving mirror to the photometer screen will properly correspond to the mean spherical candle-power,* since each band is now reduced in proportion to its circumference upon the imaginary sphere.

* The mean spherical intensity of a source may be defined symbolically under the expression $\frac{1}{2}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} I_\beta \cos\beta \, d\beta$, where I_β is the luminious intensity at any angle of elevation β.

The law of reduction which is necessary to convert the cylindrical band AC into the spherical band $A'C'$, Fig. 2, is a simple harmonic law; that is to say, the active surface of the mirror should be reduced as the cosine of the latitude.

Various devices may be employed for reducing the light reflected upon the photometer screen according to the cosine law, and it is not, of course, necessary that the active surface of the mirror should be actually reduced for this purpose.

Fig. 3 represents the side view, and Fig. 4 a front view, of our



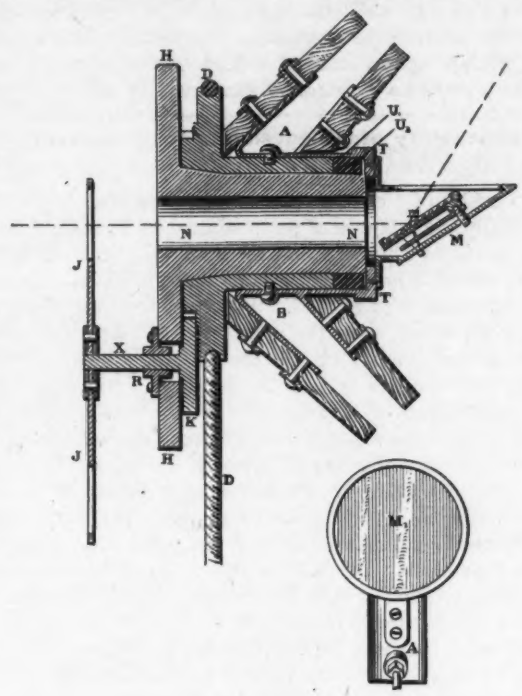
Figs. 3 and 4.

apparatus for carrying out the above plan. A plane mirror, M_1, is mounted upon the extremity of an arm of wood AA, suitably braced to avoid elastic distortion during rapid rotation. BB is a counterpoise arm, serving no other purpose than of balancing AA. These arms are mounted on a tube, TT, driven by a cord, D, from a motor not shown. The apparatus is mounted in a vertical position, with its axis in line with the photometer bar, preferably on a partition forming one side of the photometer room, so as to keep the working parts outside the room, and all extraneous light from the photometer screen. The arc is brought to the position O on the axis of the tube and photometer bar, but is prevented from throwing light directly on the photometer screen by a receptacle, M_2, which is provided with an interior plane mirror, so inclined as to throw the reflected beam from M_1 on to the photometer screen. In other words, when in operation, the illumination received by the photometer screen from the arc is entirely illumination reflected from the surface of both M_1 and M_2, through the hollow tube TT. If, now, the arms and the mirrors be revolved around the arc, a varying illumination will be received by the photometer screen according to the angle of the arms from moment to moment; but if the speed be sufficiently great, say, 1000 revolutions per minute, this illumination will be practically steady. If this illumination were not corrected for the latitude, it would not, as we have seen, represent the mean spherical candle-power of the lamp, but, by the insertion of the disc JJ, geared with the revolving tube, and provided with radial slots so proportioned that the light is cut off from point to point according to a simple harmonic law, the illumination falling upon the photometer screen is corrected for the latitude of emission, and represents the mean spherical candle-power of the arc.

Fig. 5 shows the interior of the hollow tube with its revolving arms. It is seen to be mounted upon the interior tube screwed rigidly to the partition. The mirrors M_1 and m are provided with adjusting screws, so that the light they reflect falls upon the centre of the photometer screen throughout the revolution.

Fig. 7 shows a slotted aluminum disc, geared with the tube and with the slots graduated according to a harmonic law, and with the angular velocity of the disc twice the angular velocity of the tube and revolving arms.

In order to make a measurement, the receptacle M_2 is first removed by unscrewing the clamps C C, and the horizontal intensity of the arc is directly measured upon the photometer screen without any reflectors in the usual way; say by comparison with a secondary standard, such as an incandescent lamp at high temperature. The receptacle M_2 is then replaced, and the arms are placed motionless in the horizontal position, thus reflecting a horizontal beam from the lamp by means of the two mirrors. The corresponding apparent intensity, as measured at the photometer, gives the relative reduction of light, owing to the greater virtual distance between the arc and screen as well as owing to the absorption of the mirrors. The



Figs. 5 and 6.

arms are then revolved by driving the cord over the pulley, and the measurement is repeated. This measurement, with the preceding, gives at once the ratio of the mean spherical candle-power to the horizontal candle-power. If the arms are brought to rest the candle-power can be measured in at any desired angle, and the angle of maximum intensity can readily be determined.

If a be the coefficient of reduction due to absorption and increased distance, that is, the ratio of the horizontal intensity of the arc as measured directly to that measured by double reflection, then the apparent mean intensity observed during rotation of the arms must be multiplied by $\frac{\pi}{2}a$, or 1.571 a, to give the mean spherical candle-power. Thus, if an arc lamp gives directly 450 candle-power in a horizontal direction, that is, when the mirror m is removed,

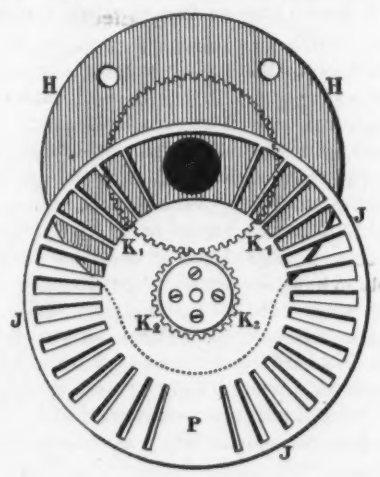


Fig. 7.

and 150 by double reflection with the mirror replaced and the arms horizontal, then if the apparent intensity during the rotation of the arms be 200 candles, the mean spherical candle-power of the arc will be $3 \times 1.571 \times 200 = 942.6$ candles.

The distance between the extremities of the revolving arms is about 37 inches. In cases where the arc lamp is so constructed as not to permit the arc to be brought to the centre, it is brought as near as is convenient to this centre in the horizontal line, and correction for the deviation can be independently determined by observt

ing the rate of diminution of spherical candle-power as the arc is moved further away.

We have assumed that the distribution of light from any arc lamp is constant in longitude, although variable in latitude. This, however, is not strictly the case. Our apparatus takes the mean value of the illumination in longitude on each side of the arc, that is, at longitudes 0° and 180°. It may be possible when so desired to revolve the source of light to be measured about a vertical axis, so as to obtain the true spherical candle-power corrected both in latitude and longitude.

The above instrument is manufactured by Messrs. Queen & Co. of Philadelphia, under application for letters-patent.

By the use of this apparatus it becomes possible to measure at one observation the total quantity of light emitted by an arc lamp at any given electric activity.

The History of Electric Lighting.

BY FRANCIS B. CROCKER.

The first electric lighting effects produced artificially were from sparks of frictional electricity. But the light produced in these early experiments was extremely feeble, and it was not until the first electrical *machine* was made by Otto Von Guericke, about the middle of the seventeenth century, that the sparks produced were sufficiently powerful and frequent to be looked upon as even the germ of the electric light. In fact, the duration of an electric spark being only an almost infinitesimal fraction of a second, it can hardly be considered to be a light of any practical use. Later, however, the frictional electric machine was improved by Newton and others, and numerous experimenters took up the study and development of electricity. One line of work which probably produced an electric light worthy of the name earlier than any other method, and one which has recently assumed particular importance, is the production of light by means of electrical *discharges* in air or other gases, whether rarefied or not. Intermittent electric sparks are entirely too sudden and temporary, unless the number of sparks is made sufficiently great to be practically equivalent to a continuous discharge.

During the latter part of the seventeenth and early in the eighteenth century numerous experiments were made with discharges in air or rarefied gas.

The record of these may be found in a book entitled "Physico-Mechanical Experiments on Various Subjects, containing an Account of Several Surprising Phenomena Touching Light and Electricity." By F. Hauksbee, F. R. S. Published in London in 1709.

The above experiments deserve to be considered as being the first production of the electric light in anything like a practical way, although heretofore they have almost wholly been ignored in so far as the history of electric lighting is concerned; but the interesting experiments of Tesla and the work now being done by McFarlan Moore with electrical discharges give these early attempts a renewed importance.

Leaving aside, however, the question of what the electric light of the future may be, it is certainly a fact that the electric light of the present day depends essentially upon the use of an electric *current* of several amperes, or a large fraction of one ampere. Frictional electric machines being utterly incapable of producing such a current, electric lighting of the kind now practiced was an impossibility until some source of electric current was discovered. The first source of this kind was the primary battery, or chemical generator of electricity, and invented by Volta in 1800. Sir Humphry Davy immediately recognized the great possibilities of the battery for scientific and practical use, and constructed a very large one of 2000 pairs of plates in 1808. This battery was used by him in various investigations; and in the years of 1809 and 1810 he performed with it the epoch-making experiment of producing a continuous and brilliant electric light, which was practically identical in principle with the arc light of to-day. This experiment is best described in his own words as follows: "When pieces of charcoal about an inch long and one sixth of an inch in diameter were brought near each other, within a thirtieth or fortieth part of an inch, a bright spark was produced, and more than half the volume of charcoal became ignited to whiteness: and by withdrawing the points from each other a constant discharge took place through the heated air, in a space equal to at least four inches, producing a most brilliant ascending arch of light."

It should be noted that in the above experiment Davy made use of *carbon* electrodes, which are the essential elements of the present arc lamp; and carbon is also used for the filament of all practical forms of incandescent lamp. He also noticed the arched form of the electric current between the carbon points, from which form the arc derives its name. This great experiment is unquestionably the foundation of the present methods of electric lighting; but the use of a voltaic battery as the source of current prevented any extensive development of the electric light, on account of the prohibitive expense and trouble of running a battery large enough to give sufficient current. A much more powerful and cheaper source of electrical energy was needed to make the electric light a practical success; therefore little or no progress was made until the discovery by Faraday, in 1831, of magneto-electric induction, which was almost immediately followed by the rapid development of the magneto-electric machine, or mechanical generator of electricity, from which has been evolved the modern dynamo-electric machine.

Very small machines were made on this new principle in 1832 and 1833 by Dal Negro, Pixie and Saxton. Later larger machines were constructed, the "Alliance" machine which originated with Nollet in 1849, being the most important example. It was afterward improved by Holmes, Du Moncel and others, and in 1863 was sufficiently perfected to be employed for electric lighting in light-houses on the coast of France.

This was probably the first important *practical* use of the electric light, and is therefore of great interest. About the same time the Wilde machines were also being used to generate current for arc lights; but these for the most part were for experimental or exhibitional purposes, These machines were up to that time of the magneto type; that is to say, the field magnetism was produced by permanent magnets. The use of electromagnets, and the principle of self-excitation as applied to the modern dynamo-electric machine, was developed by various workers, and the definite and complete invention of the principle of using the current of the machine itself to feed its own field magnet was independently and almost simultaneously announced by Werner Siemens to the Berlin Academy on Jan. 17, 1867, and by Sir Charles Wheatstone to the Royal Society of London on Feb. 14, 1867. This gave to the world the modern dynamo-electric machine, upon which, more than anything else, the great success of electric lighting and almost all the other applications of electricity depends. Another very important step in the development of the dynamo was the improvement of the armature, which up to that time had been quite crude. In 1860 Paccinotti designed, and in 1865 published a description of a machine having a ring armature with a continuous winding. This is the essential element of the very high efficiency direct-current generators of the present day. This invention was practically ignored until it was independently rediscovered by Gramme in 1870.

The invention of Paccinotti had been merely a laboratory experiment, whereas Gramme took up the subject as an engineer, and designed and constructed many successful machines of this type. In 1873 Von Heffner Alteneck applied Gramme's principle of a continuous or closed-coil winding to the shuttle armature invented by Werner Siemens in 1856. Thus for many years the history of electric lighting was practically identical with the history of the electric generator, because a good source of current had first to be obtained before any real progress could be made in applying electricity to the purpose of lighting. But the dynamo machine having been brought up to a reasonably practical form, it was available to form a solid basis for the successful development of electric lighting. At the same time that the dynamo was being improved, the problem of producing a satisfactory electric lamp was also being grappled with; but no very successful results had been obtained. Serrin in 1857, and others, had constructed arc lamps, or what were then called "regulators," which consisted of the electric arc between carbon points such as was produced long before by Davy, with the addition of a clockwork or other mechanism for feeding the carbons together as they burned away.

The incandescent lamp progressed at first even more slowly and imperfectly than the arc lamp. Crude forms of lamps were devised and made by Starr and King in 1845, Staite in 1848, and others; but none of these attempts can be looked upon as anything more than interesting experiments which laid the foundation for further progress.

The Centennial Exposition of 1876 at Philadelphia undoubtedly gave a great stimulus to electrical invention, by reason of the various forms of electrical apparatus which were collected and shown there. Most prominent among these was the telephone exhibited for the first time, and which naturally made a strong impression upon the popular as well as scientific mind.

Whether this influence did produce results or not, it is certainly a fact that astonishing progress was made in electric lighting during the years 1877 to 1880, immediately following.

At that time the great difficulty was thought to be the "subdivision of the electric light." The usual practice up to that time was to operate only a single arc lamp from a dynamo. When it was attempted to run several lamps on the same circuit, they were found to interfere with each other. In fact it was argued by many electricians that it was impossible to connect and disconnect lamps without seriously affecting the others on that circuit.

In the *Scientific American* of March 1, 1879, it is stated editorially that "the problem of electric lighting is far from solution at present," and Mr. Swendler, Superintendent Electrician of the Government of India, is quoted as saying "that each dynamo should maintain but one light, for it is only when one light is maintained by the generator that it is economical." This was only 17 years ago, and yet we now operate successfully one hundred or more arc lamps and thousands of incandescent lamps on the same circuit. The overcoming of this bugbear of "subdivision" was the aim of hundreds of electrical inventors of that time. Among the many solutions of this problem which were brought out, three are particularly prominent.

These three systems were invented and developed by Jablochkoff, of Paris; Brush, of Cleveland, O.; and Edison, of Menlo Park, N. J. In the Jablochkoff system the subdivision of the electric light was accomplished by using a form of lamp called an electric candle, which was first invented by him in 1876. It consists of two thin pencils of carbon held at a fixed distance apart by insulating material in the form of a strip of kaolin. All that was necessary to operate a number of these lights on the same circuit successfully was to connect them by wires in a simple series, so that the current flowed through them one after another. The arc formed at each lamp was of necessarily constant length, and there was no tendency for one lamp to act differently from the others, or interfere with them in any way. An alternating-current dynamo was employed to supply the current, in order that the two pencils should burn at the same rate. The Jablochkoff system has the practical difficulties of requiring a new candle to be switched on every two hours, and the cost of the candles made the light expensive. It was sufficiently developed to be used for lighting the Avenue de L'Opéra and other places in Paris in 1878, and it was also introduced and used in a few places in America; but the objections stated above prevented it from being a permanent success commercially.

In the Brush system, brought out in 1878, arc lamps with regulating mechanism practically identical with those employed to-day were operated in series on a single circuit. The success of this system was due to the fact that it included a complete set of apparatus; that is, a dynamo having a current regulator, and arc lamps with differential coil regulators and simple ring-clutch mechanism, which lamps could be operated satisfactorily in series. Brush also invented the "double-carbon" lamp; that is, a lamp in which a second pair of carbons are automatically thrown into action when the first pair are used up. This form of lamp is employed when it is necessary to run all night, which is the case with most street lamps. In short, Brush gave to the public a system in which the various elements were reasonably good in themselves, and co-operated to produce a fairly economical and generally satisfactory method of lighting, and the means and methods employed were substantially the same as those used to-day in series arc-lighting systems.

The Edison system, which was developed experimentally during 1878-1879, and brought out commercially in 1880, made use of the incandescent instead of the arc lamp, and is too well known to require description, being practically identical with the present direct-current incandescent lighting systems. Important contributions to the progress of incandescent lighting were made in lamps and other devices by Sawyer and Man, Weston, Maxim and others in America; also by Swan and Lane Fox in England. In the field of arc lighting, Thomson and Houston brought out a complete and very successful system, which had the radical advantage over the Brush system that the regulator for controlling the current and keeping it constant was superior to that employed by Brush. Indeed, the great success of the Thomson-Houston system was largely due to the very ingenious and effective regulator which they applied to their dynamo. Another arc-lighting system was brought out by Weston; but this also had the disadvantage of not having a satisfactory current regulator, although the dynamo and lamp were exceedingly well designed and constructed, considering the time at which they were made. In Europe, arc-lighting systems have been developed by Siemens, Krizig & Piette (the "Pilsen lamp"), Crompton, Gulcher, and other inventors and manufacturers; but arc lighting in Europe has never been particularly popular or extensively used, even up to the present day.

A system of electric lighting by means of alternating-current transformers was invented by Gaulard and Gibbs in 1882. This system was based on the early experimental work with induction coils by Faraday in 1831, Henry in 1832, Page in 1835, Sturgeon in 1837, Ruhmkorff in 1851, and others. Gaulard and Gibbs made the fatal error of running the transformers in series, which is impracticable. In 1885 Zipernowsky, Deri, and Blathy brought out a system in which this mistake was corrected, the transformers being worked in parallel. The alternating-current transformer system was extensively and successfully introduced in the United States in 1887 by the efforts of Westinghouse, Stanley, and others. The great saving in the amount of copper required for the distributing conductors in this system caused it to be rapidly and widely adopted. In the meantime the dynamo machine was being gradually but steadily perfected by the various inventors and manufacturers, for use in their electric-lighting systems. Edison, Brush, Thomson, Houston, and Weston, all contributed to this progress. The theoretical study of the dynamo was taken up by Clausius, Sir William Thompson, and Frölich. A great advance in the theory and practical design of dynamos was made by J. and E. Hopkinson in 1886. Their paper laid down the correct theory, and embodied a method of designing the magnetic circuit of dynamo machines, which up to that time had been very imperfectly understood; and most machines at that time were very bad in this respect. Hopkinson and Edison independently invented the three-wire system of distribution, which makes a considerable saving in the amount of copper required for low-tension circuits. Incandescent lamps have gradually been improved in cheapness and efficiency, and the mechanism of arc lamps has been perfected from time to time. Great improvements have been made in the last few years in the construction of large direct-coupled steam engines and multipolar dynamos for central stations. Enormous progress has also been made in the general perfection of the various details of electric-lighting plants. The insulation of electrical conductors has been very greatly improved. Secondary batteries have been extensively applied to electric light stations, and isolated plants, particularly in Europe, have been very largely or successfully employed, but their use is now becoming more general. This progress has, for the most part, been made by comparatively small advances at any one time, and the only radical feature which has been introduced in recent years is the polyphase alternating current. Strictly speaking, however, this can hardly be considered as part of the history of electric lighting, since its object and utility is confined to the operation of electric motors. In fact, for electric lighting alone, polyphase systems are positively disadvantageous in comparison with the ordinary single-phase alternating system. The objections to the former are increased complication in dynamos, conductors and measuring instruments, as well as the difficulty of maintaining a perfect balance on the circuits; and there seems to be no advantage of polyphase currents for electric lighting to offset these difficulties.

The two-phase system, for example, is often selected because it is better for electric lighting, the circuits being more independent than in the three-phase system; nevertheless it is obvious that nothing is gained by having two sets of circuits, measuring instruments, etc., for supplying arc or incandescent lamps. The single-phase system could accomplish just as much for this purpose and would be far simpler to install and operate.

But if motors are to be run on the same circuits with lamps, then, of course, the polyphase systems are advantageous, and for that reason they become a part of the subject of electric lighting. In this way their effect will be to materially aid the progress of electrical illumination, by reason of their double applicability to lighting and power purposes.

This brings us to the much-discussed question of the "light of the future." Will it be an improved incandescent lamp, or some sort of a vacuum tube? No prediction on this point would seem to be warranted at the present time.

But we certainly shall strive for and have reason to expect to obtain lamps of higher efficiency. A "cold light" is advocated by some and ridiculed by others, but no one can deny the enormous margin for improvement when the very low efficiency of the incandescent lamp is considered, which is never claimed to be more than 5 per cent., and is usually put at a much lower figure. There is certainly ample room for progress in this direction, and usually, when

this is the case, the advance does occur. It may be slow, but it ought to be sure.

The other great possibility for improvement is in the generation of electrical energy. What we hope for is higher efficiency and more directness than the present method, involving as it does a boiler, steam engine and dynamo, and resulting in a final efficiency of only about 10 per cent. of the energy of the fuel. Improvements in the gas engine are likely to give the higher efficiency, but will not be any more direct. Thermo-electric batteries or cells using coal instead of zinc are among the possibilities, but they do not seem to be much nearer realization than they were ten years ago.

The National Electric Light Association.

A HISTORICAL SKETCH.

The National Electric Light Association is not such an old organization that its early history has become dimmed by the atmosphere of the musty past. Its past extends back only 11 years, and the youngest of its members retains vivid recollections of its earliest

CHARLES R. HUNTLEY,
Fifth President.

EDWIN R. WEEKS,
Third President.

experiences. Its record, however, is a grand one, for the substantial benefits it has conferred upon its members and the communities in which they carry on their business.

Noble records, like noble deeds, always bear rehearsal, and as a matter of general information and interest we give below a brief summary of the work of the association from the time of its birth down to the present meeting, which is the 19th, and the third one held in New York City.

The National Electric Light Association came into being in Chicago in 1885. In pursuance of previous arrangements a large number of representatives of electric light interests assembled at the Grand Pacific Hotel on the 25th day of February in that year, and organized the association which now meets in New York for the third time.

In looking over the list of those present at the first convention one is impressed with the large number who have since "gone to that bourne from whence no traveler returns."

The meeting was called to order by Mr. W. A. Hovey, of Boston, who explained the purpose of the gathering and named Mr. George S. Bowen as temporary chairman. In his remarks on taking the chair, Mr. Bowen stated that the most important question for consideration was "What are the best means and methods for a man to adopt in order to take an electric light plant, run it successfully, make money, and declare dividends?" While this question arose at so early a date, we leave it for the members of the association to-day to decide whether it has been answered satisfactorily up to the present time.

The election of officers resulted in the selection of the following named gentlemen, J. F. Morrison, of Baltimore, president; H. M. Cleveland, of Hartford, Conn., E. M. Barton, of Chicago, and J. H. Yarbrough, of Nashville, Tenn., vice-presidents, and W. A. Hovey, of Boston, secretary.

The first serious business of the convention was an attack on the subject of "Crosses with Telephone Wires." This topic was discussed in a lively manner by several gentlemen.

At the evening session the subject of consideration was "The Best Mode of Connecting Dynamos with Power." The sense of the meeting seemed to be in favor of belting direct from engine to dynamo. The topic "Rates and Rebates on Electric Lights by the Year," was briefly considered, and several gentlemen expressed their views on the subject.

At the morning session of February 26, the question "Will Armatures Become Affected by Frost when Exposed During Transportation?" was discussed, and Mr. C. C. Haskins spoke on the topic of "Special Insulation or Guards to Insulation of Lines at Dangerous Points and Places."

At this meeting the name "National Electric Light Association" was adopted as the title of the body. After passing the usual resolutions the convention adjourned.

The second convention of the association met in New York City on Aug. 18, 1885, at the Hotel Dam. It was not until the following day, however, that the actual business of the convention was undertaken. At this meeting it was resolved to class as active members those who were engaged in the business of furnishing electric light on a commercial basis.

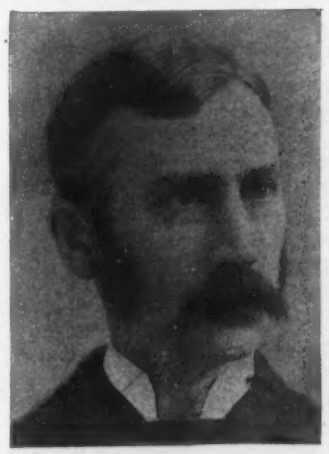
Mr. A. F. Upton, of Boston, read an address on "Steam Power in Reference to Electric Lighting." The paper was very ably discussed. At the afternoon session Mr. Leggett, of Detroit, read a paper on "Tower Lighting for Cities." "Incandescent Lights on Arc-Light Circuits" was next considered, and Mr. Leggett, of Detroit, said that no difficulty was experienced in that city in running both on the same circuit, including the tower arc lights. Dr. Otto A. Moses spoke on the subject of running arc lights on incandescent circuits.

At the meeting on the 11th, Mr. Elmer A. Sperry read an interesting paper on the "Best Form of Dynamo," and the rules he laid down were practically those followed in general at the present day. Several other subjects were considered and discussed, after which the convention adjourned *sine die*. The first record of exhibits at a convention is made as having taken place at this time.

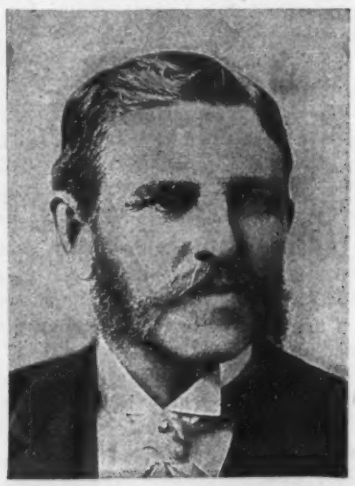
The third meeting of the Electric Light Association was held in Baltimore on Feb. 10, 11 and 12, 1886, at the Carrollton Hotel. This meeting was marked by a very large attendance. The Mayor of Baltimore extended greetings to the delegates and made an interesting address before the meeting.

The first paper that occupied the attention of the convention was that of Mr. E. R. Weeks, on the subject of "The Proper Construction and Maintenance of Circuits." Mr. Weeks gave some timely and interesting information on this important subject. He was followed by Dr. Otto A. Moses, who read a paper on "Electricity as an Illuminant." Dr. Moses's paper, which was of historical character, was followed by one giving the history of electric lighting, Mr. John W. Beane being the author. Other papers read at this meeting were "The History and Progress of Electricity as Applied to Motors," by Mr. W. J. Johnston; "Steam Power as Applied to Electric Lighting," by F. Fosdick; "Underground Wires," by Ralph W. Pope, and "The Electrical Transmission of Power," by C. J. Van Depoele. Mr. Allan V. Garratt read a paper on "Lighting from Primary Batteries," and the relations of electric light companies to insurance received considerable attention by the meeting, after the reading of a paper on the subject by Mr. C. J. H. Woodbury.

A large number of exhibits were shown at this meeting, and there



SAMUEL A. DUNCAN,
Second President.



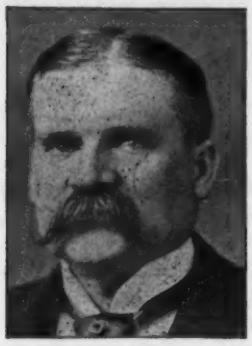
M. JUDSON FRANCISCO,
Eighth President.

was every indication of the rapidly growing strength and importance of the association.

Detroit was the headquarters of the fourth meeting, on Aug. 31, Sept. 1 and 2, 1886. President Morrison being absent, Mr. E. R. Weeks opened the session with a few appropriate remarks. A protest was read against the enforcement of electrical subways, and considerable discussion was indulged in on this important topic.

Among the papers read were the following: "Some Features of

Incandescent Lighting and Wiring," by T. C. Martin; "Wire Joints," by C. C. Haskins; "Carbons for Incandescent Lighting;" "The Adaptation of Carbon Pencils for Different Currents in Arc Lighting." by G. W. Parker; "The Operation of Motors from Electric Light and Power Stations," by T. C. Martin. The subject of the relations of the Patent Office to electric light companies and telegraph and telephone companies was liberally discussed. The discussions of topics and papers at this gathering were very profitable and interesting, and altogether it was the best meeting that the association had held up to this time.



James F. Morrison,
First President.

James I. Ayer,
Sixth President.

The City of Brotherly Love had the honor of the next convention, which was held on Feb. 15, 16 and 17, 1887, and was largely attended.

In his address, President Morrison referred to the increase in membership and influence of the association, and showed that at the first meeting, in Chicago, 53 companies were represented; at the second meeting, in New York, 74 companies; at the third, in Baltimore, 102, at the fourth, in Detroit, 124, and at the present (Philadelphia) 159 representatives had gathered.

Mr. C. C. Haskins read a paper entitled "For High Insulation." Other subjects and papers which received the attention of the delegates were one by E. R. Weeks on "Popular Prejudice Against Electric Light Wires"; "Electric Motors," by William Baxter, Jr.; "Transmission of Power by Belting," by J. H. Shay; "Steam Plants for Electric Lighting," by A. F. Upton; "Incandescent Lights on High-Tension Circuits," by Joseph Wetzler. The Legal Committee submitted a report on the reforms of the patent system, and each member was earnestly requested to use his influence in behalf of the passage of the bill by Congress relating to patents, trade marks and copyrights.

Mr. Yashima, president of the Tokyo Electric Light Company of Tokyo, Japan, gave a description of the progress of electrical engineering in his country, and for so doing was elected honorary member of the association.

The exhibits at this convention were numerous, large and representative.

The sixth convention was held at the Parker House, Boston, Mass., on Aug. 9, 10, and 11, 1887, a very large crowd being in attendance. The subject of patents came in for a good deal of consideration at this meeting, the members realizing that something should be done in the way of bringing about reforms in the patent law.

One of the most important subjects considered at this convention was that of proper insulation of wires and proper installation and construction of plants. The committee appointed to handle the subject made its report, giving what was probably the first code of rules for wire testing.

The Committee on Electrical Distribution by Alternating Currents made its report, which was discussed at considerable length.

"Electrical Education" was the subject of a paper read by E. R. Weeks. He advised the employment of intelligent persons by electric light managers, the maintenance of reading rooms, etc., for the welfare of the employes and mutual improvement societies of the men.

On the second day of the convention, Lieut. J. B. Murdock read a paper on "Electric Light for the New Cruisers." This subject evidently excited great interest, as it was discussed at considerable length.

At the third day's meeting the new constitution of the National Electric Light Association was adopted. At this session C. O. Mailloux read a paper on "The Status of the Storage Battery," which was very complete and ably discussed. During the convention a visit was made to the Thomson-Houston factory at Lynn, and in the evening of the same day a banquet was held at the Point of Pines Hotel, at which 300 persons were present. Several notable exhibits were made at this convention.

Pittsburg had the seventh meeting of the National Electric Light Association, which was held Feb. 21, 22 and 23, 1888. A large attendance was present, and in the president's address the fact was pointed out that there were in the United States at that time 3000 isolated plants and over 1000 central stations, and that the total number of arc lights was 175,000. The number of incandescent lights was estimated at 1,750,000, being about 10 incandescents to one arc light.

The papers read at this convention were: "The Practical Side of the Distribution of Alternating Currents of Central Stations," by T. C. Smith; "Underground Conduits for Arc Light Wires," by W. W. Leggett and Jesse M. Smith, of Detroit; "Electric Motors," by Dr. G. A. Liebig, of Baltimore. "The Economic Value of Steam Pressure Recorders," by Jarvis B. Edson, of New York; "Leather Belting, Its Origin and Progress," by Charles A. Schieren, of New York. "Independent Engines in Incandescent Light Stations," by W. Lee Church, of Pittsburg, and "Underground Conductors for Electric Currents," by J. M. Smith. All of these papers were of a very practical nature, and were well received and discussed.

The following named gentlemen were elected officers for the ensuing year: President, S. A. Duncan, Pittsburg; first vice-president, E. R. Weeks, of Kansas City; second vice-president, A. J. De Camp, of Philadelphia. On the retirement of President Morrison appropriate resolutions, recognizing his valuable services, etc., were passed.

The members inspected the Bentley-Knight electric railway, which was then in operation in Allegheny City, and other places of interest were visited.

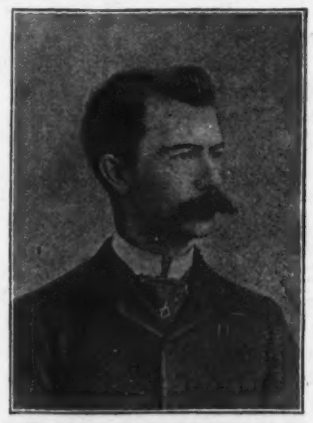
For the second time, New York had the Electric Light Convention, the eighth, which was held on Aug. 29, 30 and 31, 1888. Members from all over the country were present. In his address, President S. A. Duncan reviewed the progress in electric light matters during the interval since the last meeting. His report was very satisfactory. Mayor Hewitt was introduced and made a very interesting address of welcome to the delegates and paid a very high compliment to those engaged in the growing industry.

Several valuable papers were read, among which were the following: "Petroleum Fuel," by S. S. Leonard, of Minneapolis; "Overhead and Underground Wires in New York," by S. S. Wheeler; "The Comparative Danger of Alternating *vs.* Direct Currents," by Dr. P. H. Vanderweyde. A revised constitution of the association was adopted at this meeting.

Mr. E. R. Weeks read a paper on "Electrical Education," giving some very practical hints on this important subject. The association, at this meeting, resolved to establish a permanent office in New York City, to be in charge of the secretary and treasurer. The social features of this convention were numerous and interesting, and the exhibits were large and various.

The ninth meeting was held in Chicago in the Exposition Building, on Feb. 19, 20 and 21, 1889. The steady increase in membership and interest in the association and its meetings was evidenced by the large attendance and enthusiastic participation in the proceedings.

Marsden J. Perry,
Fourth President.



Edward A. Armstrong.
Seventh President.

President Duncan's address gave some interesting and valuable statistics as to the progress of electric lighting and electric railways. The Committee on Patent Legislation made a long report, setting forth the progress made in that direction.

Several valuable papers were read at this meeting, and the discussions on some of them were very lengthy and interesting. The subject of electric light stations, as fire risks, was considered and discussed at considerable length. Oil fuel also received a great deal of attention at this meeting, and municipal lighting made its appearance for the first time as a subject for consideration by the association. The exhibits at this convention were very numerous, being larger in number than at any previous convention.

The following named gentlemen were elected officers for the year: President, E. R. Weeks, of Kansas City; first vice-president, A. J. De Camp, of Philadelphia; second vice-president, E. W. Maher, of Albany.

With a view to pleasure, at well as business, the members of the association, for the tenth time, met at Niagara Falls on Aug. 6, 7 and 8, 1889.

Among the most important papers read at this meeting was that on "The Value of Economic Data to the Electric Light Industry," by Mr. Allen R. Foote. The constitutionality of execution by electricity was also discussed, and old laws on the subject of execution were quoted and discussed at considerable length. Electric traction by storage batteries also received attention, Mr. William Bracken reading a paper on that subject. The exhibition at the World's Fair came up for consideration at this meeting, but inasmuch as the place for holding the Fair had not been settled upon, no definite action was taken.

The eleventh convention was held in Kansas City, Mo., on Feb. 11, 12, 13 and 14, 1890. This meeting led all previous ones in the amount of work done, the actual results accomplished, and the value and importance of the papers and discussions. In the matter of entertainment and enjoyment the courteous attention everywhere received and the pleasure derived was unequaled by any other former conventions. The eastern members made the trip to Kansas City on a special train, and a very enjoyable time was had. President Weeks made an address of welcome, and reviewed in general the state of the electric art and industries.

Among the most important papers read at this meeting were those on "The Steam Engine," by Fred Sickles, of Kansas City; "The Economical Generation of Steam for Electric Light Stations," by George H. Babcock; "A Universal System of Central Station Accounts," by T. Carpenter Smith; "Carbon Tests," by E. F. Peck, and "Safety and Safety Devices in Electric Installations," by Prof. Elihu Thomson. Much other important business was transacted at this convention, which required four days for the completion of the work in the end. The election of officers resulted as follows: President, M. J. Perry, Providence, R. I.; first vice-president, Prof. E. W. Maher, Albany; second vice-president, C. L. Edgar, of Boston. The exhibits outnumbered those at any previous convention.

The twelfth convention was held at Cape May, N. J., on Aug. 19, 20 and 21, 1890, where the members could take a dip in the ocean between times. The meetings were held in the Stockton Hotel, and the selection of this location resulted in attracting a very large attendance, a great many ladies being present.

The World's Fair, which was then beginning to loom up, received considerable attention at the hands of the association, and a general plan for the electrical exhibition was discussed. Municipal lighting was attacked in a paper by Mr. M. J. Francisco, and discussed very freely by a large number of members. Several other valuable papers were read.

Providence, R. I., was the place of the thirteenth convention, on Feb. 17, 18, and 19, 1891. This meeting it will be remembered was one of the most successful ever held by the association, and the exhibits occupied an entire hall, and were very large and numerous. The convention was held in the Masonic Temple near the Narragansett Hotel, where the association headquarters were located. Many valuable papers were read, and the report of the Committee on Data on the Comparison of Economy in the Generation of Power has since been accepted as a reliable reference on the subject of the generation of steam. There was a very large attendance at this convention.

The memorable convention in Montreal on Sept. 7, 8, 9 and 10, 1891, was the fourteenth held by the association and probably in its social features the pleasantest ever held. The most prominent citizens of Montreal, headed by the Governor-General himself, graced the occasion by their presence, and the manner in which the people of the city entertained the delegates and guests constitutes one of the pleasantest memories of those who were fortunate enough to be present on this occasion.

The World's Fair at this time began to assume concrete form, and it will be remembered how Dr. Hornsby, who was then on his way to Europe to engage the interest of foreign countries in the great enterprise, described the plans of the electrical exhibition. The journey of delegates from New York to Montreal by special train was a pleasant one and the party was met at St. John, near the border line, by a committee of Montreal citizens who had two bagpipers with them to give the Americans a true Canadian welcome. The sound of bagpipes is not very pleasant to American ears, but under the circumstances the Yankees joined in the spirit of the occasion. The banquet at the Windsor Hotel was a great success and was attended by Lord Stanley, Governor-General of Canada, Sir Donald A. Smith and other prominent Canadians.

The convention listened to many valuable papers and discussions and altogether this meeting was one of the most successful ever held in the history of the organization. The exhibition of electrical supplies and apparatus was held in the Victoria Rink, and was very extensive and successful.

The fifteenth convention was held in Buffalo on Feb. 23, 24 and 25, 1892. President C. R. Huntley, whose home is in Buffalo, acquitted himself in the most admirable manner in the matter of providing entertainment for the members during their leisure moments.

The meeting was a great success, and the quality of the papers read was of a high standard. The members on one afternoon during the convention made a trip to Niagara Falls and inspected the work then in progress on the Niagara power plant. The World's Fair also came up for discussion, and Prof. Elisha Gray explained the plans for the Electrical Congress at the World's Fair. Mr. James I. Ayer, of St. Louis was elected president for the ensuing year; Judge E. A. Armstrong, of Camden, N. J., first vice-president; and C. H. Wilmerding, second vice-president.

St. Louis had the honor of the sixteenth convention on Feb. 28 and March 1 and 2, 1893, and although the distance for the Eastern delegates was great, the attendance was very large. As usual on these occasions, the Eastern delegates traveled to the theatre of action in a special train, quite a number of ladies being in the party. Mrs. M. J. Francisco gave a beautiful souvenir to the ladies present in commemoration of the pleasant meeting, and Mr. C. O. Baker, master of transportation, was presented by the New York delegation with a magnificent gold-lined silver punch bowl and ladle. This gift was a token of the appreciation of the Eastern members of the able manner in which Mr. Baker provided for their welfare.

Important topics in connection with electric lighting were discussed at considerable length at this meeting, and after the election of officers, the convention adjourned to meet in Washington the next time.

On Feb. 27 and 28 and March 1 and 2, 1894, the City of Washington was taken possession of by the members of the Electric Light Association for their seventeenth meeting. Judge E. A. Armstrong, president of the association, called the meeting to order, and delivered an address full of life and practical information. Papers of the usual high class were read, and the convention adjourned to meet in Cleveland the following year.

The Cleveland meeting—the eighteenth—was held Feb. 19, 20 and 21, 1895, and was largely attended by delegates from all over the Eastern and middle sections of the country. The papers and discussions at this meeting are of such recent occurrence that no special reference to them at this time is required. The convention elected Mr. C. H. Wilmerding president for the ensuing year; Frederic Nicholls of Toronto, first vice-president; and E. F. Peck, second vice-president.

This brings us down to the present time, and the nineteenth meeting which is now being held in the American metropolis, will unquestionably far surpass any of its predecessors. THE ELECTRICAL WORLD has told its readers during the past few weeks of the great preparations being made for the electrical exposition which is to be held in connection with this meeting, and the delegates will no doubt repair to their homes with the feeling that their association is one destined to exert great influence in the progress of the electrical arts and industries.

Röntgen Rays in Mining.

It is reported that Dr. J. C. Perry and W. C. Cheney, superintendent of the Portland General Electric Company, have been very successful in defining free gold in quartz by means of Röntgen rays, as plainly as if it lay on the surface.

Since the Last National Electric Light Convention.

Several events have transpired since the last meeting of the National Electric Light Convention, held in Cleveland last year, which will have a more or less important bearing upon the history of electrical development. The advancement of the year has however been mostly in the line of solid engineering, although improvements and progress have shown themselves in other important particulars. Considering the year chronologically we must record the Bate refrigerator decision as being the first event of importance to occur after the Cleveland meeting. Following this the destruction of Tesla's laboratory on South Fifth Avenue, New York City, was a catastrophe which was regretted by all. In the death of Mr. George M. Phelps, the electrical fraternity lost a warm friend, and one whose service will prove a lasting benefit to the electrical profession. The decision of the United Circuit Court of Appeals, sustaining the validity of the Berliner patent, was accepted with considerable dissatisfaction by rival telephone companies.

Two great events in electric railway annals for the year were the electric locomotive equipment of the Baltimore & Ohio Belt Line tunnel at Baltimore, and the inauguration in Chicago, of the first elevated electric railway in the country. The installation of the conduit system of electric railways on Lenox Avenue, New York City, was another event of almost equal importance in electric railway progress. The Nantasket Beach Road attracted wide attention, as did also somewhat later the successful operation of the Connett-Budapest system in Washington. Then we must not forget the alternating-current, rotary-transformer railway system at Norwich, Conn., which was a step in the right direction. The Westinghouse-Baldwin combination, as far as the production of electric locomotives is concerned, gave a huge impetus to this branch of electric railroading.

In electric lighting, the storage battery received much marked attention, and became recognized as a desirable adjunct to central-station equipments. Most excellent results were achieved in such plants as the New York, Brooklyn, Boston and Lawrence Edison stations, and 1895 has been referred to as the missionary year, in so far as the wholesale conversion of central-station managers to the use of the storage battery is concerned. The growing favor of gas-engine central stations in Europe has been much discussed since last year's convention. Decorative electric lighting also has materially advanced during the same period, and in this connection must be mentioned the decision of the Roman Catholic Church authorities to permit the use of the incandescent lamp in churches, except where the rubrical light, wax candles, and olive oil are considered necessary.

The great advances made in long-distance transmission of power are subjects for comment by electric lighting men. The starting of the Niagara Falls power plant was the most significant event in this line, although the whole story has not yet been told. Visitors to the exhibition will be treated to a sample of its energy and to a limited conception of what it is like, by means of a large working model of the Niagara plant. Throughout the West, large installations have been made, notably the Sacramento-Folsom transmission plant, the Silverton, Col., plant, and that at Fresno, Cal.

Acetylene gas attracted a great deal of attention, and perhaps some uneasiness, on account of the claims made regarding its cheapness, but the test of time has not illustrated any marked developments in its use. The object to produce a motor vehicle has been the means of bringing several electrically propelled carriages to the front, but in the present state of the development it does not appear that the era for this device has yet arrived.

The Atlanta Exposition, held during the Fall of last year, was not only instructive, but inculcated an important object lesson equalled by few similar expositions. The consolidation of the Edison Electric Light Company and the Pennsylvania Light, Heat & Power Company, of Philadelphia, was an event not without its own significance. So was the annulment of the two-carbon arc lamp patents and the confirmation of the verdicts of the lower courts in the arc regulator and Sawyer-Man filament cases. In the death of Franklin Leonard Pope, due to an accidental electric shock in October last, the profession lost an earnest worker and one who will be greatly missed from the present convention.

The announcement of the discovery of a new form of invisible ray by Prof. Röntgen may be termed the most dramatic as well as the most important announcement, not only of the past year, but many previous years as well.

The agreement made between the General Electric and Westinghouse companies, in regard to certain patents, may be expected to produce an important influence on some phases of electrical manufacture.

Among the more important of the meetings which have been held may be mentioned the annual meeting of the American Institute of Electrical Engineers at Niagara, the American Association for the Advancement of Science, the Canadian Association and the Northwestern Electrical Association. The electrical literature of the year has assumed formidable proportions, too much so, in fact, to allow of consideration here.

These are the most important events of the year, and as the chronicle is now up to date, there remains but the one event, the present convention, to complete the list.

President Wilmerding.

We present herewith the features of the gentleman who occupies the chair of the president of the National Electric Light Association—Mr. C. H. Wilmerding.

Mr. Wilmerding will exercise the authority of his high office in his native city; he therefore cannot be classed as a stranger within our gates, although the scene of his active duties at the present time is in the Queen City of the West—otherwise Chicago.

Mr. Wilmerding was born in New York City in 1858, and received his education largely abroad—in France and Germany. He afterward entered and graduated from Yale College in 1879 as a civil engineer. He followed his profession at first in the East, and afterwards went to Colorado and engaged in mining and railroad work for several years. In 1884–85 he was assistant engineer on the new aqueduct in New York City, and in 1888 the possibilities of the electrical profession attracted his attention. He went to Chicago in the fall of that year and became superintendent of the Chicago Arc Light & Power Company, and subsequently its general manager. When that company consolidated with the Chicago Edison Company, Mr. Wilmerding became manager of the operating departments of the combined companies.

President C. H. Wilmerding.

Mr. Wilmerding is one of the most active members of the National Electric Light Association, and is a gentleman of sterling qualities

According to the law of the Association, Mr. Wilmerding will, at the New York meeting, turn over the authority of president to his, as yet, unknown successor, but the organization will, no doubt, continue to derive benefit from his wise counsel.

Lord Kelvin's Jubilee.

The American Institute of Electrical Engineers has been invited to send a representative to take part in celebrating the jubilee of the professorship of the Right Hon. Lord Kelvin, which will take place in Glasgow, June 15 and 16.

President Duncan has appointed Past-President Thomas Commerford Martin to represent the Institute on this interesting occasion. Mr. Martin will sail on June 6, and while absent will lecture before the Royal Institution on the subject of the Niagara power plant. He will be absent several weeks, and during his trip will visit his old home near London.

A Few Suggestions For Convention Visitors.

THE non-resident members of the National Electric Light Association and their friends will doubtless be interested to know of some of the many attractive features to be found in New York, together with the points of especial importance in the field of electricity. When the papers have all been read and the sights at the Exhibition have been examined, the following attractions are suggested for diversion and at the same time profitable information.

While standing some evening on the Thirty-third Street station of the elevated road, and looking up and down Broadway, one may obtain one of the best examples of the use of the electric light, both for illumination and for advertising purposes. On all sides the theatres, cafés and stores display electric devices. Herald Square is ablaze with light, and the whole scene is symbolical of the living presence of the electric current.

If possible, it might also be well to go up into some high building which rises above the ordinary house tops, or to some one of the high towers, as that of Madison Square Garden, the finest in the city, in order to obtain an excellent panoramic view of Greater New York and its outlying districts.

The Church of St. Francis Xavier, West Sixteenth Street, is well worth a visit, as it contains one of the most artistic and effective of interior illuminations. Some of the illuminating stations will afford the visitor a good way of spending an off day and evening. The itinerary may include the following: The stations of the Edison Illuminating Company, on Duane and Elm Streets, Twelfth Street, near Third Avenue, West Twenty-sixth Street, West Thirty-ninth Street and West Fifty-third Street. The total output of all these stations, forming one common system, is 3000 arcs and 218,000 incandescent lamps. At Eighteenth Street and Avenue A will be found the station of the Manhattan Electric Light Company. This plant supplies about 20,000 incandescent lamps in the neighborhood. On the other side of the city, at Van Dam and Greenwich Streets, is the Mount Morris electric plant, which supplies 12,000 arc and 30,000 incandescent lamps. The United Electric Light & Power Company, East Twenty-eighth Street and East River, supplies 4500 arc and 40,000 incandescent lamps. The New York Heat, Light & Power Company, whose plant is at No. 35 Gold Street, supplies 50 arc and 8000 incandescent lamps. The East River Electric Light Company, at 425 East Twenty-fourth Street, supplies current for 4800 arc and 10,000 incandescent lamps. The plant of the Brush Illuminating Company is situated at

HERALD SQUARE.

208 Elizabeth Street, and supplies 2500 arc lamps. The large operating rooms of the Western Union Telegraph Company will doubtless prove of exceeding interest. They are situated at Broadway and Dey Street. The operating rooms of the Postal Telegraph Company, should be visited at Broadway and Murray Street, and at the same time a cordial welcome will be given to those who may call at the offices of THE ELECTRICAL WORLD in this building.

The large telephone exchange at 18 Cortlandt Street, and the new exchange on Broad Street, will afford, together with the exhibit of the Metropolitan Telephone Company, a very complete idea of the New York telephone systems.

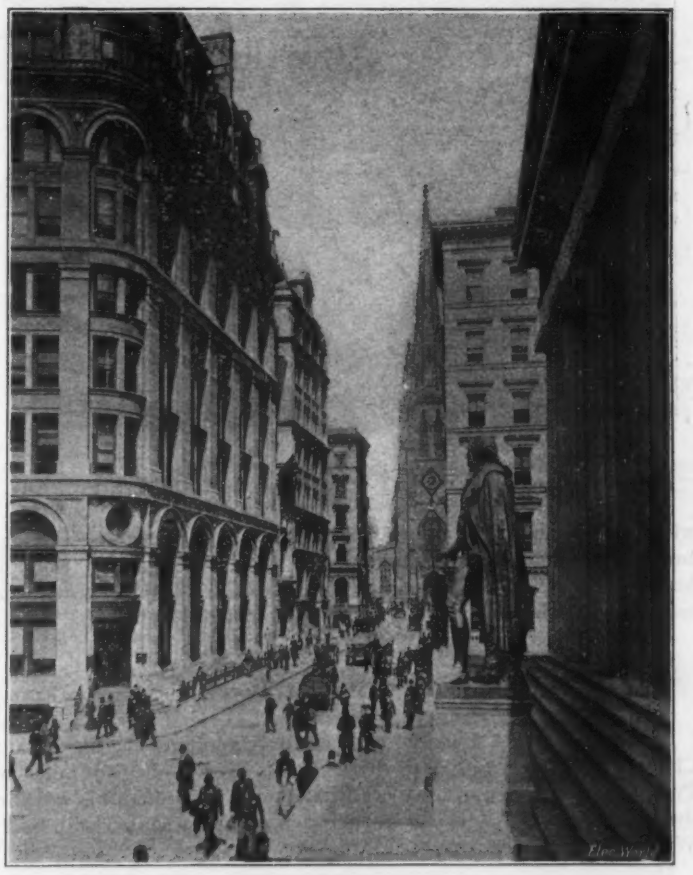
From the Postal Telegraph Building the visitor may take a Broad-

THE BOWERY.

way car, connecting at 109th Street and Columbus Avenue with the underground electric conduit system, which has been a signal success and an important feature of uptown development. The power-house is located at 146th Street and Lenox Avenue.

The above might be called the technical institutions of the town. The more popular sights will not be less interesting.

Central Park contains many features of interest, the principal one



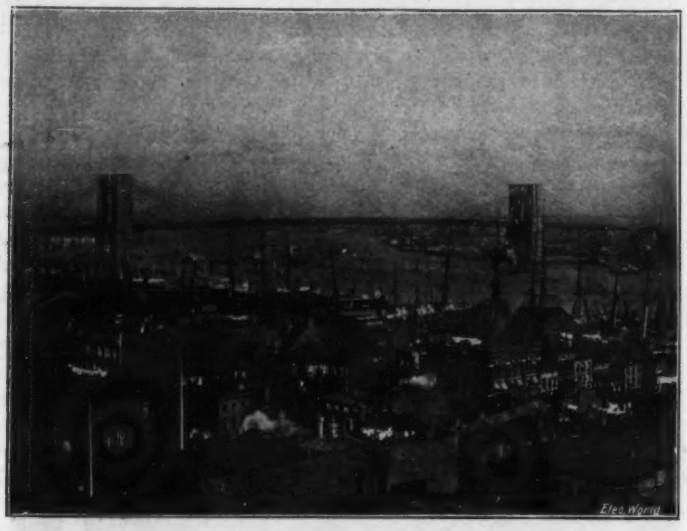
WALL STREET.

being the Metropolitan Museum of Art, the Museum of Natural History and the Obelisk.

A walk or drive along Riverside affords a beautiful view of the Hudson and the Palisades, and will include a view of the Acropolis, now nearing completion.

The lower part of the city includes the New York & Brooklyn Bridge, the Tombs, Post Office, some of New York's wonderful buildings, Wall Street, the Sub-Treasury, the new Clearing House and the Stock Exchange.

A walk up the Bowery affords an insight to the most cosmopolitan



East River Bridge.

street in the world. Chinatown, Governors' Island. Liberty Statue, and a visit to the Brooklyn Navy Yard, just above the Bridge, in Brooklyn, will prove to be sights worthy of attention.

The above are the principal sights and attractions of New York City. There are many minor points of interest which may be visited

"The Terrace," Central Park.

with profit by members of the National Electric Light Association, but which cannot be included here, owing to lack of space. Enough has been mentioned, however, to compose a first-rate itinerary, one we may add which should prove in every way enjoyable.

Honors to Prof. J. Perry.

Prof. J. Perry, of London, has just been appointed to the vacant Chair of Mechanics and Mathematics at the Royal College of Science. Prof. Perry is known to the electrical fraternity through his work in that field, particularly in the earlier days when associated with Prof. Wm. Ayrton.

The Electric Light Association of Pennsylvania.

The annual meeting of the Electric Light Association of Pennsylvania was held at Harrisburg, April 9, last, with an attendance the largest in the history of the association, much interest in its work and plans being shown by those present and in letters received from others. The necessity of organized work and a united membership to look after the interests of the companies throughout the State was generally admitted and plans discussed to effect it.

The desires of the different companies for data regarding the operation of other plants to aid them in making comparisons with their own plants were recognized, and uniform blanks were adopted for the compilation of such information, the data to be at the disposal of members of the association; in all other respects to be considered as confidential.

The question of future legislation was referred to a committee, to be appointed by the president, the president to be chairman of such committee and to have power to select assistance as he may deem advisable, with instructions to draft such bills as may be thought necessary for the proper protection of lighting interests throughout the State; such bills, when drafted, to be reported and passed on by the association at a special meeting to be called for the purpose.

The needs of the several companies were discussed, and as far as possible directed to be embodied in the bills to be prepared.

It was decided to use every effort to add to the membership during the coming Summer and Fall, and to this end to ask the help of all its members in increasing the numbers and strengths of the association. With the enormous amount of capital invested in electric lighting in Pennsylvania, it is advisable, and indeed necessary for the protection of such investment, that concerted action be taken by all concerned.

The following officers were unanimously elected to serve for one year: President, Robert E. Wright, Allentown; vice-president, P. B. Shaw, Williamsport; treasurer, R. D. McGonnigle, Pittsburg; secretary, John R. Wheeler, Pittsburg.

Executive Board: A. J. De Camp, Henry Clay, Philadelphia; John A. Rigg, Reading; C. A. Wolle, Bethlehem; John S. Rilling, Erie.

With the following Auxiliary Committee: Howard Rinek, Easton; E. H. Davis, Williamsport; J. T. Maxwell, Philadelphia.

The meeting adjourned to meet at the call of the chairman.

At the Exposition.

The Bi-Metallic Electric Transmission Company, of New York, will show samples of bi-metallic wire in the exhibit of the John A. Roebling's Sons Company. Mr. W. M. Miner will be in daily attendance.

The Joseph Dixon Crucible Company, Jersey City, N. J., will have an exhibit of graphite products and articles of interest to all electrical industries. The company will occupy space No. 126, Section F, main floor.

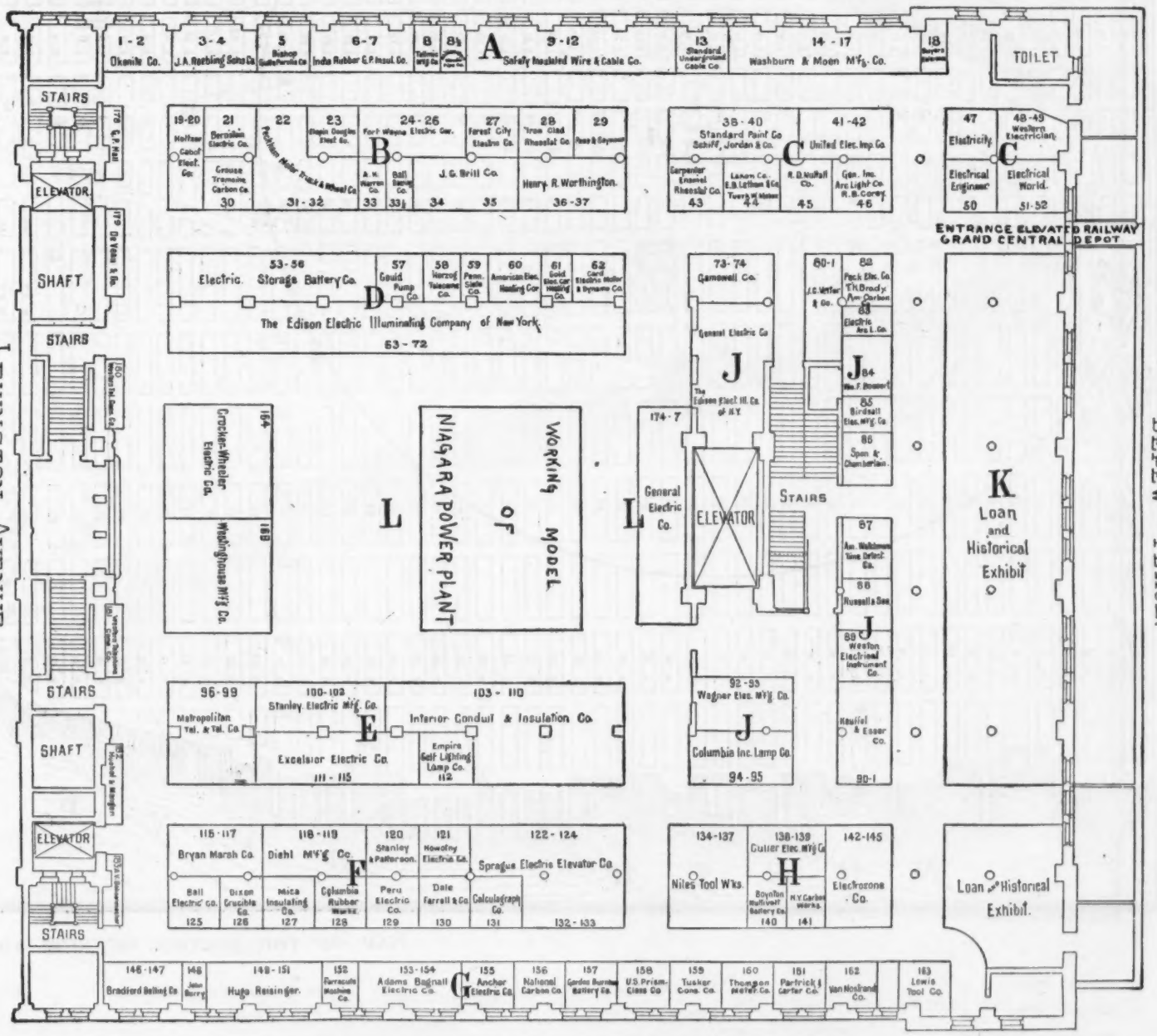
The Fiberite Company, Mechanicville, N. Y., will display a full and complete line of its insulating materials for overhead trolley equipment and Medbery insulation. They will also display a very handsome line of switches of every kind, as well as a very handsome switchboard for lighting and power purposes. This display will be in charge of Wendell & MacDuffie and Mr. H. J. Medbery.

A Notable Collection of Portraits.—A collection of over 200 autograph portraits, comprising all the great celebrities of the electrical art and a number of men now rising to prominence or active in the field, has been formed by Mr. W. J. Hammer. These, in nine handsome framed groups, have been loaned by him to the Exposition, where they will be appropriately displayed. The collection not only includes Americans, but is rich in rare photographs of the leading electrical spirits of Europe.

Electricity on the Erie Canal.—Upon the request of Mr. Frank W. Hawley, who has been so actively and prominently engaged in the application of electricity to the Erie Canal, Mr. Richard Lamb, the civil engineer and inventor, whose electric bank-haulage system was put in operation last year at Tonawanda, has worked out a beautiful and costly model of the whole thing, and Mr. Hawley has placed it at the disposition of the National Electrical Exposition. It will be located as an adjunct to the model of the Niagara power plant, which is to stand in the centre of the main floor, and the intention is to run it by some of the stored power from Niagara, switching over occasionally to the regular circuits of the building. The model is no less than 40 feet in length, 6 feet in height and about 3 feet wide. The canal will have 8 inches depth of water in it. There will be 8 poles, 5 feet apart, and a ¼-hp motor will furnish a more than liberal supply of motive-power to a string of three boats.

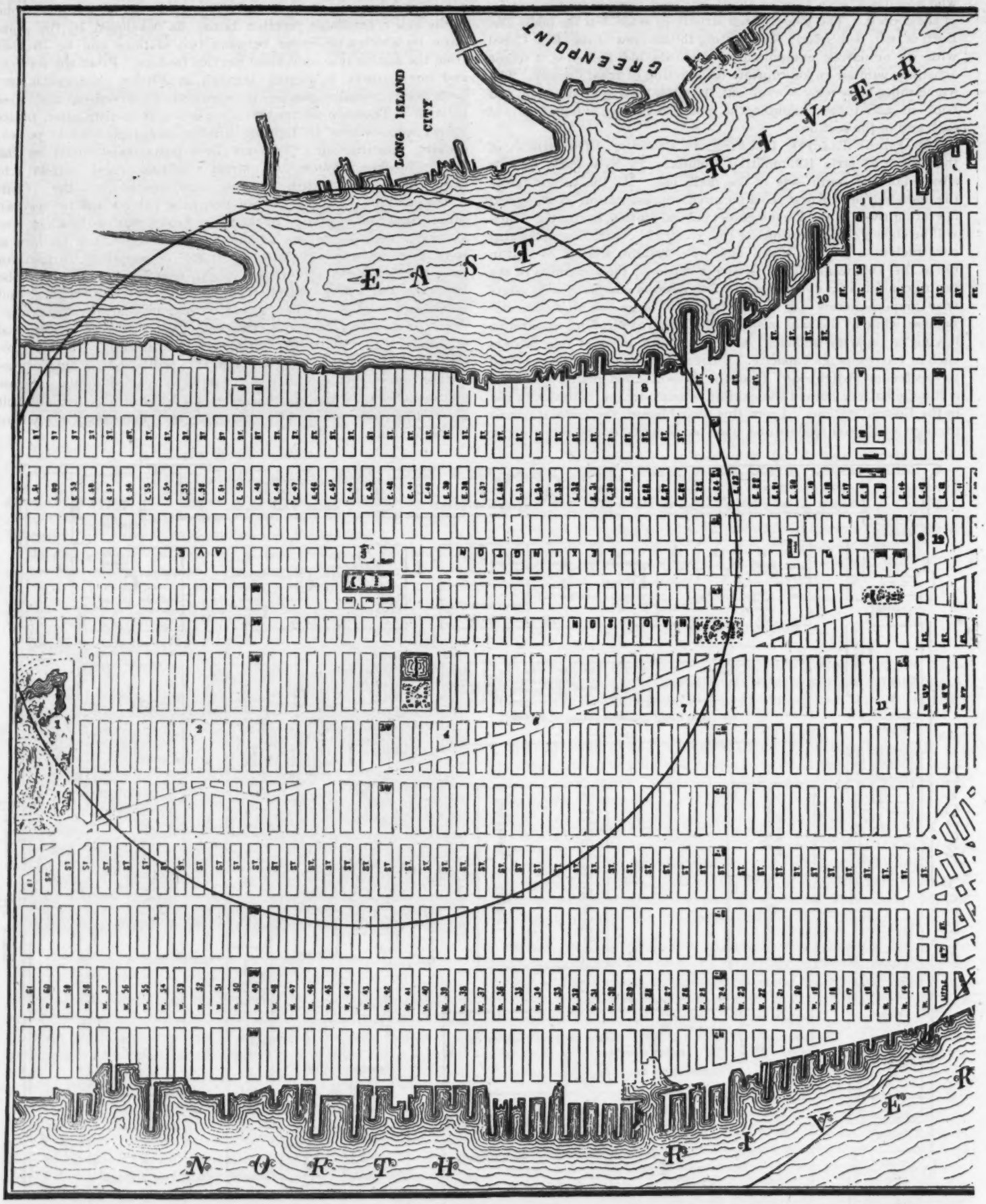
The latest innovation in canal and lake freighting is the use of steel barges and the owners of these, the Consolidated Canal Company, who now has a large number afloat, has built three small *fac-similes* of these craft. The model is not strictly to scale, but the boats are. Each is two feet long. As a setting to the view of the Erie Canal with its miniature equipment of methods old and new, a scenic artist has painted an appropriate background of rural scenery. The whole thing is cleverly worked out, the "tow" going up the canal and back in about two minutes, the motor reversing automatically at each end of the section.

THE EDISON ELECTRIC ILLUMINATING COMPANY.—The exhibit of the Edison Electric Illuminating Company, of New York, will be situated on the south side of the main hall. As the visitor enters the main hall he will first see a pictured representation of the great operating room of the Duane Street central station, in front of which will be shown actual sections of the electrical controlling apparatus constructed on the Van Vleck edgewise system, similar to that in use at the Duane and Twelfth Street stations; the apparatus in the centre consists of a dynamo controlling section complete, with edgewise ampere-meters for regulating two large-size multipolar dynamos; while at the side is shown the feeder-controlling apparatus, having a capacity sufficient to control both poles of four feeders each of 1000 amperes capacity. Current for this exhibit is supplied to this feeder switchboard from the Edison street mains, and from a storage battery behind the exhibit, similar to the batteries in use in the Edison stations. From this switchboard, the current passes through an Edison feeder-tube, such as is used in the city streets, after which it passes into a feeder box, thence to a distributing box, and thence through a street main to a service-end box, such as is placed on a consumer's premises. Alongside the feeder box is one of the new controllable junction boxes, as developed by the company, by which a tie-feeder between two stations can be divided from the station into individual service feeders. From the service-end box current is carried through an Edison chemical meter, such as is usually placed in a customer's premises, and also through a Thomson wattmeter; after which it is distributed for its varied applications in lighting (incandescent and arc), power, cooking, heating, etc. Two arc light posts, constructed on the Edison-Bowker system of street lighting, and similar to those in use on Fifth Avenue, are placed at the front of the exhibit. In the centre of the main exhibit will be seen an illuminated representation of the upper field frame of the huge 800-kw dynamos now in use at the Duane Street station, the largest lighting generators in the world, capable of supplying current for more than 12,000 16-cp lamps. In the next space beyond will be shown an interesting collection of various electrical, surgical and dental apparatus, together with electric fans and an electrically-driven sewing machine. Electric cooking is also shown in practical operation, with electric ironing and electric heating; an "electrotherm" for bed-warming, poulticing, etc., will also be of interest, as well as many other applications. The power exhibit at the extreme end includes a modern printing press run by electricity without belt or shafting; elevators run by electric current are shown elsewhere in the building.



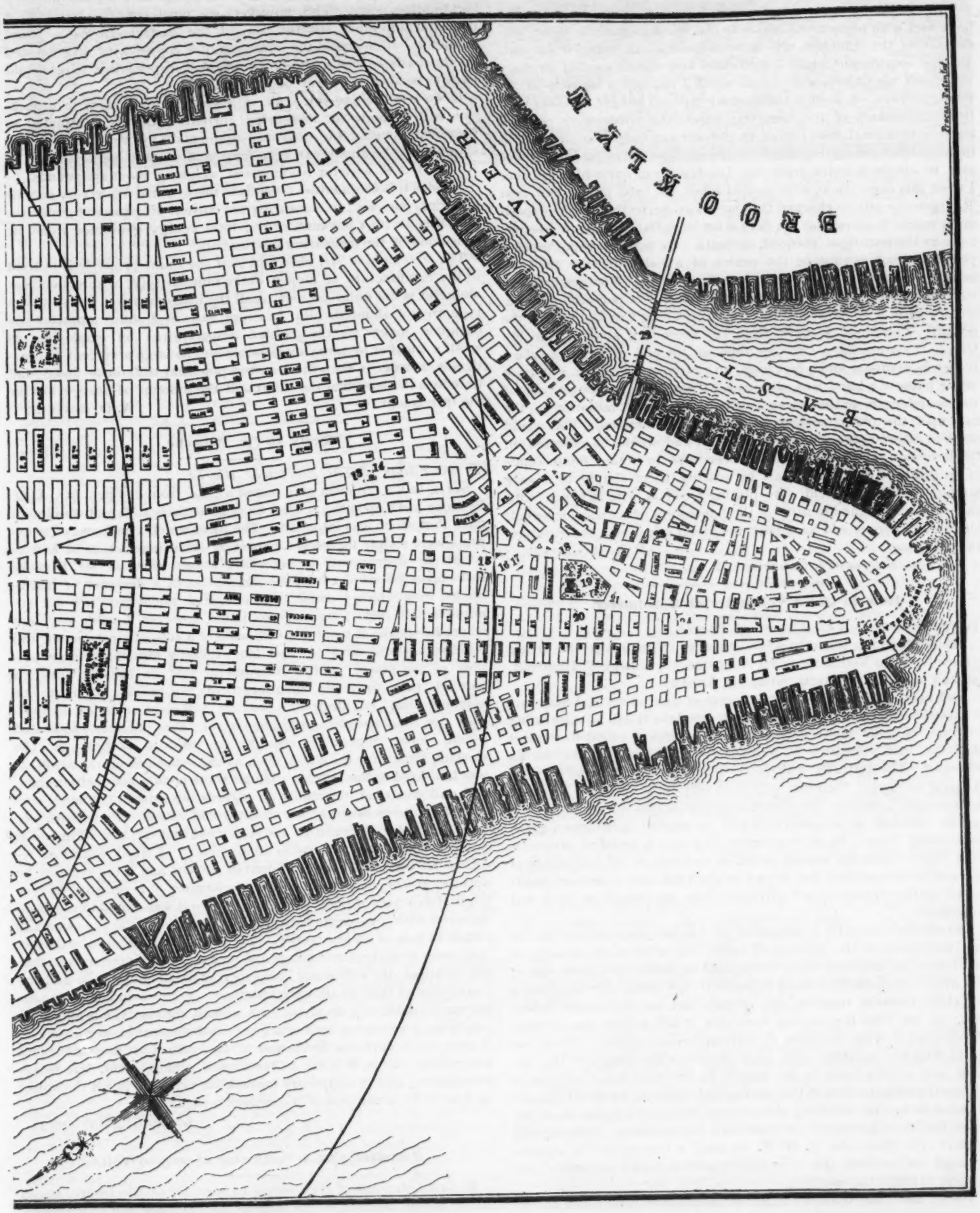
FLOOR PLAN OF THE ELECTRICAL EXPOSITION.

The above plan gives the location of the exhibits on the main floor of the Exposition Hall.



MAP OF THE SECTION OF NEW YORK

1. Central Park.
2. Edison Station.
3. Exposition Building.
4. Edison Station.
5. Theatre District.
6. Madison Square Garden.
7. Edison Station.
8. United E. L. & P. Company.
9. East River Light Company.
10. Manhattan Electric Light Company.
11. St. Francis Xavier's Church.
12. Edison Station.
13. Brush Company.
14. Bowery.
15. New Court House.



CITY BELOW CENTRAL PARK.

16. Tombs.
17. Edison Station.
18. World Building.
19. City Hall.
20. Postal Telegraph Building.
21. Post Office.
22. Brooklyn Bridge.
23. N. Y. Heat, L. & P. Company.
24. Western Union Telegraph Company.
25. Wall Street.
26. Telephone Exchange.
27. Navy Yard.

Are Röntgen Rays Induced Currents?

To the Editor of The Electrical World:

Sir:—In all the experiments which I have thus far performed, I have met with phenomena which to my mind seemed to show evidence that the Röntgen ray is analogous to an induced current. The last experiment which I performed and which seemed strongly to support my theory, was one in which I charged a Leyden jar by Röntgen rays. I used a three-quart jar and hung a Crookes tube from the centre of the same on wires; the wires were covered entirely by a small lead tubing to prevent any induction effect from them. After generating the Röntgen rays for a few seconds I was able to obtain a spark from the Leyden jar of quite high tension. I tried this experiment with several tubes, the tube giving the best Röntgen-ray effects charged the jar most perfectly. This experiment seems to show that the rays must be radiating lines of electric force in the nature of induced currents. In another experiment I placed a Crookes tube in the centre of a helix of wire (No. 30), using about 1000 feet; upon generating the Röntgen rays I obtained quite a spark from the wire terminals. Upon placing a secondary upon a primary coil, and inserting a long Crookes tube in the primary, I obtained a spark from the secondary about 1¼ inches long. Upon placing a Crookes tube at the end of a brass tube 2 inches in diameter and 3 feet long, an electro-sciagraph of a portion of the palm of a hand was obtained. Upon using a spiral tube of the same length, so that there could be no direct radiation of the rays upon the plate, no electro-sciagraph was obtained. This would seem to disprove the sound-wave theory, and would be expected on the induction theory. I have also been able to obtain fluorescence of tungstate of calcium crystals by placing them simply in a very strong electrostatic field. By placing a coil of wire in a box with calcium crystals the intensity of the fluorescent effect was increased. Of course, there would have been the direct effect with the Röntgen rays, anyway.

F. L. Woodward.

Harvard University, Cambridge, Mass.

How to Use a Voltmeter as a Ammeter.

To the Editor of The Electrical World:

Sir:—Allow me to make a few remarks in regard to the article "How to Use a Voltmeter as an Ammeter," by George T. Hanchett, printed in The Electrical World of April 25.

As I have been obliged in the course of time to write, I may say, a hundred letters on the same subject, I believe it will be interesting to some of your readers to have their attention called to the fact that the best voltmeter is practically the worst for use as an ammeter. Theoretically, a perfect voltmeter should take no current. A good voltmeter therefore will take very little current. In every instrument based on the electromagnetic action of the current a certain number of ampere-turns will be needed to balance a given controlling force. In an instrument having a permanent magnetic field these turns are wound on the movement, in an instrument of the soft iron type they are wound on the field, and in an instrument based on the dynamometer principle they are wound on field and movement.

In order to obtain for a voltmeter the needed ampere-turns with a minimum current, the number of turns has to be made as large as possible. As, however, these turns must be wound in a given space, the wire is necessarily a small diameter. Let us say, for example, a certain instrument requires one ampere-turn for a full-scale deflection. If we wind it with one turn only it will require one ampere. If we wind it with 100 turns it will require .01 ampere. These 100 turns, roughly speaking, will have 100 times the length of the one turn, and as they have to be wound in the same space we have to reduce the cross-section of the conductor to one one-hundredth that of the one turn. In reducing the current from one ampere to .01 we have therefore increased the resistance 10,000 times. It hence will require 100 times the E. M. F. to send a current of .01 ampere through the 100 turns that it would require to send a current of one ampere through the one turn.

Under the three different types of instruments mentioned above, the one with a permanent magnetic field requires for a given controlling force the smallest number of ampere-turns, as the current has not to build up the field as in the two other types. In the Weston voltmeter the permanent field is as strong as possible, the weight of the moving parts as light as possible and therefore the controlling force can be a minimum. These instruments require for a full-scale deflection .63 ampere-turn which is made up by 63 turns on the movement with a current of .01 ampere. As these 63 turns have a resistance of 63 ohms, the instrument requires, without any serious resistance, a difference of potential of .63 volt between the binding posts. This, however, we must consider too high a potential difference for the use of the instrument as a shunt ammeter. If we build the shunt out of a copper wire dimensioned on the basis of one square inch per 1000 amperes this wire would have to be about 80.7 feet long.

If we use the five-volt scale of a 500-volt instrument in connection with a shunt for measuring current, which is designated as "eminently suited for such measurements" by Mr. Hanchett, our shunt would be about 641 feet long, and would have to consist of No. 00 B. & S. wire for 100 amperes, weighing about 256 pounds.

Besides this mechanical objection, there would be a very serious electrical one, viz., in measuring the current of a 500-volt generator with this device 1 per cent. of the total energy generated would be consumed by the measuring instrument.

The statement of Mr. Hanchett that the shunt principle is utilized in the manufacture of almost every familiar type of direct-current ammeter is not quite correct, as all the instruments of the soft iron type are not shunted. But in every case of a shunt ammeter the designer makes up the needed ampere-turns by employing as small a number of turns as possible and as large a current as practicable in order to keep the required potential difference down and to reduce the length of the shunt and the amount of energy lost in the instrument.

A. O. Benecke.

Reply to Mr. Benecke.

To the Editor of The Electrical World:

Sir:—In his criticism of a recent article from my pen, Mr. A. O. Benecke looks upon the subject from an entirely different standpoint from that which was intended. The ideas which I endeavored to express were simply to assist a person at such times when he had to adapt the instruments at hand to his uses, whereas Mr. Benecke looks upon the subject from the standpoint of a designer of instruments, from which premise, of course, such makeshifts are not admissible. In remarking upon his letter, however, I would say that where he speaks of using a 5-volt scale of a 500-volt instrument and building a shunt some 641 feet long, thereby utilizing a large portion of the power in the instrument, that he has not drawn a parallel case to those mentioned in my article. It is to be assumed that an electrician having sufficient technical knowledge to manipulate instruments in the manner indicated would have ingenuity enough to use a portion of the working circuit for the shunt, such as the series-coil of a dynamo, as was indicated in the article. Under those conditions, both mechanical and electrical objections as regards the amount of energy consumed by the measuring instrument would vanish. I must also join issue with Mr. Benecke in the statement that the best voltmeter is practically the worst for use as an ammeter. A good voltmeter requires an extremely small amount of current and if the pressure be applied *at the terminals of the mechanism*, it is sensitive to very slight differences of potential and therefore is well suited to use as an ammeter with low-resistance shunts, which are usually the easiest to obtain in case of an emergency. This is further evidenced by the fact that some of the best voltmeters and ammeters have mechanisms that are identical, the difference being merely in the magnitude and the connection of their auxiliary resistances. For use in laboratory experiments with very small currents when a high voltage is all that is available, a voltmeter with a large series-resistance is very useful, as it cuts these currents down and at the same time measures them accurately. True, it is not an economical arrangement, but in experimenting and in temporary makeshifts economy is not the object as it must be in the case of instrument design.

George T. Hanchett.

Standardizing a Voltmeter of 20,000 Volts.

M. Javet, director of the Central Laboratory of Electricity, stated at the recent meeting of the Société International des Electriciens, that he had succeeded in standardizing a voltmeter to be used in measurements as high as 20,000 volts. It is a Lord Kelvin instrument of the electrometer type consisting of two quadrants, and a aluminum needle carrying two perpendicular axes, the screws on which allow of adjusting the axis of suspension with the centre of gravity. The small weights are of special form and being of three sizes permit of obtaining three degrees of sensibility, the readings indicating 100, 200 and 400 volts respectively for each division.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous and Non-Synchronous Motors. BOUCHEROT. *L'Eclairage Elec.*, Vol. 5, No. 44; abstracted in the *Jour. Inst. Elec. Eng.*, April.—He criticises the controversy which took place lately and ended in favor of the synchronous motor. He makes a number of comparisons between the two kinds of machines; the question of efficiency is of greater importance theoretically than practically, as the difference is slight; it is incorrect to believe that the efficiency of a non-synchronous motor can be increased by converting it into a synchronous one, as the contrary is the case; the non-synchronous motor behaves as a synchronous one, the exciting power of which would vary automatically with the resisting torque; the only method of satisfactorily converting a non-synchronous into a synchronous motor is to considerably increase the air gap. He gives and compares the data for a motor of each kind. Regarding starting, he thinks it impossible that the synchronous motor could start as well as a non-synchronous one, for if this result is obtained it would jeopardize the good working of the motor when synchronized. With regard to the lag, the synchronous motor has a distinct advantage, for with proper variations of the field it produces no lag, whereas the non-synchronous produces a lag of at least 30 degrees; a non-synchronous motor reacts more strongly on a generator than an equivalent number of lamps. He thinks that the use of an over-excited synchronous motor to compensate for the lagging will never be a success, as the laws due to over-excitation alone would prohibit their use; he thinks condensers will eventually be used for this purpose. In conclusion, the objections prohibiting the use of synchronous motors in preference to non-synchronous are: their lower efficiency, greater difficulty in starting, and the greater complications and consequent care.

Operating Motors at a Distance. REYVAL. *L'Eclairage Elec.*, April 11.—A well-illustrated description with complete diagrams of the wiring, of a system for starting, in either direction, and stopping an electric motor of any power, from a distance; the system has been in use in a large number of places, especially on board ships; the chief feature is a switch operated electrically and having carbon terminals for taking the spark: illustrations of the application are given.

Experimental Determination of the Losses in Continuous-Current Machines. SEIDENER. *Zeit. f. Elek.*, April 1.—A reprint of a paper describing how the various losses may be determined by electrical methods, with the use of only simple electrical instruments and without the absorption of a large amount of power for large machines; the series and the parallel system are described when two similar machines are being tested; also a method which may be used with 4 and 8-pole machines but not with 2 and 6-pole machines.

Tri-phase Machinery. GIRAULT. *L'Ind. Elec.*, April 10.—A long well-illustrated description of the three-phase generators, motors and transformers, as made by the Fives-Lille Company in France.

LIGHTS AND LIGHTING.

Lighting by Arc Lamps. BLONDEL. Lond. *Elec.*, April 17; a continuation of his serial.—He discusses the question of globes and reflectors. From a photometric point of view the naked arc is perfectly satisfactory, as more than 85 per cent. of the light is sent downward and there is a loss of only about 10 per cent. in the glass, but from a physiological point of view it is very bad on account of the great brilliancy, which contracts the pupil of the eye; this quite balances any of the advantages from a photometric standpoint; "it is difficult to understand how American cities can adhere to a system which has such a very fatiguing effect on the eye; we are forced to believe that the public takes no more care of the preservation of its sight than of its stomach. In Europe more attention is paid to this point." He thinks naked arcs should be prohibited for public lighting except on very high pillars; with clear glass globes there is about a 10 per cent. reflection, which sends a much greater portion of the light upward than would be imagined from the photometric curves of the naked arc. Diffusing globes are almost exclusively used on European thoroughfares; they have the defects that they absorb a certain portion of the light, which varies from 20 to 40 per cent., and they alter the distribution, sending more or less of the light upward which would otherwise pass downward; to avoid this the arc might be placed not at the centre but in the upper portion of the globe, almost in the plane of its opening; he favors focusing lamps and thinks that the reason that the position of the arc keeps changing is the one why the well-known American lamps have been abandoned almost entirely in France notwithstanding their simplicity. The luminous efficiency of the globe for making comparisons should be the ratio of the hemispherical flux utilized and the total flux. He gives briefly the results of tests made by others, among which is a set of four curves by Guthrie and Redhead for the naked arc, and for the clear, ground and opal globes; omitting the last, which he thinks is incorrect, the efficiencies are 51.3, 53.7 and 21.7 per cent. To reduce the absorption there is often an insufficient opalescence, and one then loses more, owing to the physiological effects, than is gained photometrically. He does not recommend at all the roughened (ground) glass globes, as only a portion of the surface appears brilliant, this being equivalent to a too transparent opaline globe; besides this they get very dirty. Regarding reflectors he states that diffused reflection is more generally employed, owing to the inherent disadvantages of bright reflectors; a good white enamel reflects and diffuses about 80 to 90 per cent., which is almost as great as that of a silver mirror; to place the reflector outside makes the lamps "even more ugly"; it is not sufficient to have the reflecting surface in the neighborhood of the source and it should subtend a large enough solid angle, care being taken not to confuse the solid angle with a plain angle, as grave errors may thereby be committed; the reflector should also be adapted to the particular photometric curve; a reflector above the globe, if given the usual dimensions, "can play only an almost imaginary part," as it reflects only the rays which are sent upwards from a small portion of the globe; in Europe hood reflectors have been almost entirely abandoned and a small reflector placed in the interior of the cupola is used instead, but he thinks this arrangement can scarcely be of any use, as this portion receives only a very insignificant part of the light; he concludes that reflectors as usually employed have only a slight effect on account of their form, and even then they look hideous; the hood reflectors may be of use for lighting places like factories, but they do not meet the requirements of public lighting and he thinks the same may be said of all other combinations of mirrors and reflectors.

Arc Lighting from Railway Circuits. *L'Ind. Elec.*, April 10.—Referring to the statement that in a certain part of Paris arc lights are being run from railway circuits, as described in the *Digest*, April 25, it is stated that the price agreed upon is 28 centimes (5.6 cents) per lamp-hour for 10 ampere lamps, while throughout Paris, with one other exception, the price is 40 centimes (8 cents). It includes furnishing and maintaining the leads, the lamp fixtures and lamps, carbons, globes, etc., and for the current, that is, all except furnishing, erecting and maintaining the candelabras, (presumably meaning the ornamental lamp posts); the contract is for 20 years.

Domestic Lighting with Acetylene. *L'Ind. Elec.*, April 10.—A short article by E. H.

Vacuum Tube Lighting. MOORE. *Elec. Eng.*, April 29.—A reprint of the complete Institute paper, with the illustrations.

POWER AND HEAT.

La Goule. BRUNSWICK. *L'Elec.*, April 11.—An illustrated description of this transmission plant, which has been referred to before in these columns.

TRACTION.

Cost of Traction in Europe. DUMONT. *Mem. Soc. Ing. Civ.*, January.—A brief review of the report of a commission on the various systems of traction by electricity; the report gives the following figures, showing the consumption of coal per car kilometre: For the trolley system at Havre 1.7 kg, for the accumulator system in Paris, with the old cars 2.6, and with the new cars in which energy is stored on down grades, 1.85; for the compressed-air line in Paris 11.0; for the Serpollet steam line in Paris 2 to 3.

Traction Scheme for London. Lond. *Elec. Rev.*, April 17.—A brief note stating that at present there is under consideration a project to purchase all the existing street railway lines of London, changing the motive power from horses to electricity, using an underground conduit system, the particulars of which are not yet disclosed; the entire service will be controlled by a great railway trust; at present the scheme is only on paper.

Rules and Regulations for Electric Railways. *Elek. Zeit.*, April 16.—A reprint of the rules prescribed by the Kingdom of Prussia governing the construction of electric railways and circuits.

Heilmann Locomotive. DE GRIEGES. *Mem. Soc. Ing. Civ.*, February.—The original of the article, an abstract of which was noticed in the *Digest*,

March 21 and 28; it includes a diagrammatic illustration of the "Fusee," and the one at present under construction.

Rouen. L'Elec., April 4.—A long, illustrated description of the line in that city, installed by the Thomson-Houston Company.

Baltimore Tunnel Locomotives. Duncan. *Elec. Rev*, April 29; an abstract of a recent paper.—He states that the smallness of the leakage in the overhead construction has exceeded all expectations, considering the dampness in the tunnel; the working voltage is 650; the service of the motor for the month of December is given, showing an average horse-power per train of 891, and a total number of trains of 365. It has been found that there is quite a knack in starting the train, and the present operators, who have become quite skilled and were formerly old steam-engine men, say they can accelerate a train without jerks better than with the steam locomotive. The pull of the locomotive was measured with a dynamometer car, from which the draw-bar pull per ton of train on the 0.8 per cent. grade was calculated, and was found to be 22 pounds, which, after subtracting the grade pull of 16 pounds, left a difference of 6 pounds as the train resistance per ton, confirming D. K. Clark's figures; the draw-bar pull per ampere was found to be 28.6 pounds. An electrician on the locomotive is not necessary, as the present locomotive engineers operate it very successfully; the current indicator is a great assistance to him and enables him to avoid slipping the wheels. Acceleration was measured by taking two second readings and plotting the curve; a train of 985 tons could be accelerated up to a speed of about 12 miles an hour in one minute; he doubts whether steam locomotives could equal this. A draw-bar pull of 80,000 has been inserted; a speed of 61 miles an hour up grade has been reached, and this would mean 70 or 80 on a level; with a 300 or 400-ton train a speed of 40 to 45 miles an hour can be made; the weight of the locomotive is 194,000 pounds.

Electricity on Steam Railways. Baxter. *Elec. Eng.*, April 29; a continuation of his serial; (see *Digest*, last week).—He shows the saving that could be made in the operating expenses of the Pennsylvania Railroad by the substitution of electricity for steam, by taking the reports of this road and showing how figures would be changed; this road was selected because their reports are given more in detail; a table gives the operating expenses for 1894; the sum of the items, which can be reduced by the adoption of electricity, amounts to over $17,000,000, which is nearly 42 per cent. of the total expenses; another table gives the wages and salaries. The cost of repairing the roadway he thinks can be reduced at least 20 per cent. and that of the repairs of bridges about the same; the cost of repairing locomotives is over 78 per cent. of that of the fuel and over 7 per cent. of the entire operating expenses, it is therefore nearly as large an item as the coal; he thinks that 70 per cent. of the entire cost of the repairs of the locomotive would be saved.

Electricity on Trunk Railways. Baxter. *Sc. Amer.*, April 18.—A short article discussing the subject in a general way. It contains little more than a general summary of the series of articles which is being abstracted in these columns.

Manhattan Elevated Railway. Eng. News, April 30.—A note stating that it is proposed to expend $25,000,000 in extending the system above the Harlem River and erecting a double-decked system from the Battery to the Harlem River, operating the whole by electricity; it is expected to run ordinary trains from the Battery to Yonkers in 40 minutes and express trains in 30 minutes; the express time now is one hour.

Operation of Compound-Wound Generators in Parallel. Woodbridge. *Elec. Ry. Gaz.*, April 30.—An article of an elementary character describing the action of railway generators when connected in parallel.

Methods of Controlling Railway Motors. Baxter. *Elec. Ry. Gaz.*, April 25.—The beginning of a series of articles explaining the principles and the application of the rheostat, the commutated field, and the series-parallel methods.

Three-Phase Line at Lugano. Elec. Ry. Gaz., April 25.—A translation with the illustration of the article abstracted in the *Digest*, April 18.

Scranton. Elec. Ry. Gaz., April 10.—A reprint of an illustrated description of the plant.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Costs. Lond. *Elec.*, April 17.—A supplement consisting of a large table showing the total capital outlay, receipts and expenditures for the past year of statutory electric supply undertakings in London and the Provinces.

High-Voltage Lamps and Their Influence on Central-Station Practice. Addenbrooke. *Jour. Inst. Elec. Eng.*, April.—A reprint of the complete paper (see *Digest*, March 28 and April 4).

Electricity in the Italian Navy. Dary. *L'Elec.*, April 18.—A brief, illustrated description of the machines and other electrical apparatus.

WIRES, WIRING AND CONDUITS.

Wiring Table. Scott. Lond. *Elec. Rev.*, April 17.—A reprint of a small table which he has been using for the past three or four years; the description is not quite clear; it appears that the distance to the furthest lamp is used to determine the current density in that circuit, as indicated in the table.

Wiring. Jour. Inst. Elec. Eng., April.—A reprint in full of the continuation of the discussion on Bathhurst's and Mavor's papers; abstracts appeared in the *Digest*, March 14 and 28.

ELECTRO-PHYSICS AND MAGNETISM.

Progress in Radiography. Lodge. Lond. *Elec.*, April 10. An article giving the results of his recent observations.—He states that the focus tubes, as now in the market, can stand as much power as can be applied to them by an induction coil with a make and break; alternating currents as a primary source are unsuitable; a quick sharp break is much better; Leyden jars are quite unnecessary; a break under alcohol he found was best; a well exhausted tube can be used for hours with a voltage almost sparking between its terminals outside of the glass; the vacuum improves with action and ultimately gets too good, in which case the application of a Bunsen flame restores it to activity; although calcium tungstate is much cheaper, yet he believes that *potassium*-platino-cyanide is the better; neither should be powdered, but should be used in minute precipitated crystals, combined with a clear varnish, several layers of which will make a good screen. It is quite easy to see through every part of the human body, but he has not been able to get satisfactory details; he is not sure whether this is due to the light being too dim for discrimination even though it is apparently bright, or whether these penetrating rays make less distinction than ordinary rays between bone and other less dense material. The sensitive plates of only the best makers are of any use; he does not think that the isochromatic property is an essential help; development may be safely pushed very far. He is not sure whether the film was acted on from the glass outwards, instead of from the surface of the film inwards. Regarding the source of the rays, he states having reached definite results from many experiments; when the rays from the cathode impinge first on the glass surface, then that surface is the source, the glass radiating X-rays just as a red-hot surface radiates light, and there is no mutual interference as there would be from a number of similar sources in phase; experiments show that if these rays are waves at all they must be very small; there is nothing yet to discriminate between longitudinal and transverse oscillation, but the latter seem more probable, but it is not certain that they are waves at all; if the wave length is comparable to the size of the molecules, the question of whether they are transverse or longitudinal is of minor importance. When the cathode rays first strike a plate of metal in the bulb, then its behavior depends largely on which pole this plate is connected to; it is certain that if this plate is attached to the cathode, rendering it unable to receive the charges, then it either declines to act as a source or emits but a feeble radiation, which can be attributed to a secondary cause; but if connected to the anode then it acts as a most vigorous source; in a low vacuum it will get hot, but in a high one the bulb keeps perfectly cool, the whole energy passing off as X-rays. He illustrates a bulb with a cup-shaped anode, a disc as a cathode, and an inclined plate in the middle between the two, permanently connected in the tube with the anode (thus making a sort of double anode, one in front of the other); his experiments with this tube show undoubtedly that the rays do not start from the cathode, or anything attached to it, but from the surface upon which they strike. When the glass walls, instead of receiving cathode rays, are pierced only by the true Röntgen rays from the disc in the middle, the glass does not seem to act as a source; its phosphorescence then is not of the least use; if it diminishes by reason of fatigue, it is not of the slightest detriment; by drawing the rays to the side with a magnet, the fresh portion of the glass looks bright, but there is no difference in the Röntgen rays: the phosphorescence of the bulb is an index, but has no further advantage; the quality of the glass is of some importance, but he doubts that there is any great advantage in using aluminum instead; tungstate of calcium is notably opaque, from which he concludes that a non-fluorescent substance is better for the source of the tube; uranium glass would be a step in the wrong direction. The focus tube gives about the best defined results possible; potassium instead of barium-platinocyanide seems better. He does not lay much importance on the property of discharging positive or negative electricity, as this requires extreme precaution in the experiments, because experiments on electrostatic discharges are open to a variety of disturbing causes; he verified Prof. J. J. Thomson's discovery, that the discharging power is due to insulators becoming non-conductive, but any differences between different metals, or between positive or negative discharges, remain open to doubt. Platinum foil kept white hot by means of a current is about as opaque as a cold piece. Regarding X-rays in sunlight, he claims that proper experiments should be made on the tops of high mountains, because the atmosphere is equivalent to over 2 feet of mercury, and must therefore entirely screen these rays from lower levels; Alpine tourists have often reported a fogging of plates which was unaccountable. The fluorescing power of these rays seem to show that they possess plenty of energy; the use of fluorescing sensitive films may be a step in the right direction, but a fluorescent coating near the film tends to scatter and diffuse the light, and the shadows are not as clear and sharp; much work must yet be done to discover the most suitable kind of a film.

Reducing the Time of Exposure with Röntgen Rays. L'Ind. Elec., April 10; abstracts of several Academy papers.—Meslin found that by using

electric or permanent magnets for creating a field perpendicular to the cathode rays in the interior of the tube, these rays may be concentrated, thus increasing the intensity for photographing purposes; this also enables the rays to be deflected to different parts of the tube, which is important because the point on which the rays are condensed are gradually covered with a light brown deposit which makes that spot inactive. BASILEWSKI diminished the time of exposure by placing a sheet of fluorescent paper on the surface of a sensitive film; he also obtained good results with bi-sulphate of quinine, but the exposure is twice as long as with the usual barium salt. IMBERT and BERTIN-SANS also used a magnet to condense the cathode rays. MESLIN in a second paper shows that the magnetic field should not be uniform, as it must deflect and condense; in acting on these rays at the neighborhood of the cathode it is best to use those parts where the lines of force concave upward; the field then performs the function of a cylindrical mirror and there is then a luminous horizontal line produced; this may be condensed in the other direction by increasing the intensity of the field; by this method he obtained a good photograph of a hand in five seconds; he claims to have found that the use of a fluorescent layer next to the sensitive film gives less favorable results than are obtained by not using it. CHAPPUIS increased the action in the ratio of 8 to 5 by concentrating the cathode rays by means of a magnet; by substituting the Foucault interrupter for the usual hammer, the time of exposure was reduced in the ratio of 40 to 1; this result he thinks is due to the difference of the breaking spark in the air and in the alcohol; a high frequency seems to be detrimental; the power of a tube diminishes rapidly with the use of high frequencies; with a frequency of four brakes the tube retained the same power for more than 20 minutes, from which he concludes that the invisible fluorescence persists at least a quarter of a second; with a lower frequency the tube heats less; the commercial tubes lose their power rapidly; a tube acts well when the pressure is about one five-hundredth of a millimetre of mercury.

Deflecting Röntgen Rays by a Magnet. LAFAY. *L'Ind. Elec.*, April 10, and *L'Eclairage Elec.*, April 18; an Academy paper.—He endeavors to find whether there is not a change in the nature of the rays accompanying the phenomena of the discharge of the electrified bodies as produced by these rays; he thinks these modified rays ought to be affected by a magnetic field. A screen of lead having a small hole was placed below a Crookes tube, and below this another one, the opening in which was closed by a thin foil of silver carrying a platinum wire; the silver foil was connected to the negative pole of the induction coil which operated the tube, so that the rays which passed through were influenced by the electrification; the electrified rays were then passed between the poles of an electromagnet of 400 cgs units field strength, after which they were received on a photographic plate; by a suitable device the deflection, if it occurred, was made double that produced, so as to make it more easily noticeable; the results left no doubt of the correctness of his hypothesis, as a deflection was obtained, the direction of which was determined like that of the cathode rays acted on by a magnet; he repeated the same experiment, but without electrifying the second screen, which showed that an electric field has no apparent action on Röntgen rays. The latter journal contains also a later paper from *Comptes Rendus*, April 7; by using an influence machine as a source he found that the result was not the same when the foil was electrified positively with the same machine, the direction of the deviation being then reversed; he concludes that there exist Röntgen rays electrified positively and others electrified negatively; he thinks the Röntgen and the cathode rays may be identical. A tube which he used ceased to operate, and he then heated it to 200° C., which restored its former properties; whenever it gives out he reheats it again with the same success.

Properties of Röntgen Rays. GALITZINE and KARNOJITZKY. *L'Ind. Elec.*, April 10; abstract of an Academy paper.—They made photographs on which the points of emission are clearly shown, and which leaves no doubt that the centre of emission is at the anode; in reversing the poles the new anodic centre is formed where the cathodic centre was before, but the latter is always more intense. The question of whether the rays are longitudinal or transverse can be decided by finding whether there is polarization; they therefore used three very thin plates of tourmaline, arranging them in various ways and photographing them by means of these rays; if there is polarization the X-rays will be less intense where the plates cross each other; the action of light was carefully excluded; in the eight tests one can see that where the plates were crossed the action on the sensitive plate was less; from this they concluded that the X-rays can be polarized and that they are therefore transverse vibrations.

Origin of Röntgen Rays. PERRIN. *L'Ind. Elec.*, April 10; an abstract of an Academy paper.—From experiments he concludes that the X-rays are developed on the neutral walls of the tube, generally at points where an obstacle lies in the path of the cathode rays; in general therefore points of any material which arrest the cathode rays develop Röntgen rays.

Röntgen Rays.—The *Proc. Lond. Phys. Soc.*, April, contains among the foreign abstracts a large number of the papers on Röntgen rays which are classified under the subject of "light"; most of them have been noticed, though not quite as fully, in the *Digest*. Among those which have not been noticed are the following: In a paper from the Italian by SALVIONI he stated among other things that the position of the focus of the cathode rays is altered by touching the tube with metallic points connected to the ground or to the cathode; the rays are deflected to a point on the tube exactly opposite to that touched by the conductor; the best position of the latter is at a distance from the cathode equal to the radius of the curvature; although tubes may be constructed so that the focus always falls on the wall of the tube, yet it is found that through use the glass loses its fluorescence, showing a dark spot; the use of the metallic point enables the position of the fluorescent spot to be changed from time to time.—In a paper from the Italian by BATTELLIS and GARBASSO they concluded that the pear-shaped globe is the best, and that the induction coil is preferable to the influence machine, although it heats the electrodes more; they prefer the Tesla coil, exciting it with the induction coil. An experiment to find whether electromagnetic radiations acted on the sensitive plate gave negative results, although the exposure was three hours; they confirmed Röntgen's statement that the fluorescence of the glass is intimately connected with the production of the rays, and fluorescence excited by the ordinary light did not produce the rays; they believe that the photographic action is a secondary one due to phosphorescence; to find if the substances in immediate contact with the sensitive film have any influence, photographs were taken on a glass plate, a celluloid film and an "autotese" film; the celluloid film gave only a very faint image as compared with the other two, but on placing a fluorescent screen behind the celluloid film a very intense image was obtained. They have been unable to find any indication of refraction, although they obtained a slight deviation through a prism; they have definitely established the existence of reflection, although it is more of the nature of a diffusion. They give the following list of bodies, the occasional numbers representing the degree of transparency as compared with water, which is taken as equal to 1. *Solids:* Cork (4.3), pine-wood, walnut, paraffin, gutta-percha (1.1), sealing-wax, stearine, soft charcoal (0.9), asbestos, ebonite (0.8), cardboard, horn, flannel, celluloid, whalebone, silk, cotton (0.7), hard charcoal, starch, sugar (0.6), bone, magnesium (0.5), coke, retort carbon, glue, sulphur, ivory, chalk (0.4), aluminum, steatite, glass, calcium carbonate (0.33), antimony (0.13), tinfoil, zinc, tin, iron (0.1), nickel, brass, cadmium, (0.09), copper, bismuth, silver (0.07), lead (0.055), palladium, mercury (0.044), gold, platinum (0.02); *liquids:* sulphuric ether (1.37), petroleum, ethyl alcohol, methyl alcohol (1.2), olive oil, benzine, water, hydrochloric acid (0.86), glycerine, carbon disulphide, nitric acid (0.7), chloroform, sulphuric acid (0.5). A curve between density and transparency is roughly a rectangular hyperbola; the opacity of wood does not increase proportionally to the thickness.—In a paper by RAVEAU he states that the Helmholtz and Ketteler theories of absorption lead to the conclusion that for extremely rapid ultra-violet waves any body would have a large absorption band beyond which the index of refraction would fall asymptotically to unity and there would neither be reflection nor refraction, all bodies being transparent.—In a paper from the Italian by SELLA and MAJORANA they state having found a distinct reflection from zinc, brass, silver and tin, and none from glass or wood; the end of the tube on which the cathode rays fell is strongly electrified and no diminution in the intensity of the radiation was noticed on silvering this, but if the metallic covering was connected to the earth, the radiation was almost annulled; a sheet of tinfoil not in contact with the glass appeared perfectly transparent whether connected to the earth or not.—In another paper from the Italian by DUTTO he states that he injected into the arteries of the hand of a corpse a solution of sulphate of calcium, a salt which is opaque to Röntgen rays; it was sufficiently dilute to enter the smaller veins; a Röntgen photograph of the injected hand showed the whole system of arteries very distinctly and they were even more opaque than the bones of the hand; (the use of the stereoscope as suggested by E. Thomson, in connection with such photographs might show very interesting results).—A pamphlet by MEWES, presumably in German, is also abstracted at some length; it is of a theoretical nature.—A paper from the Italian by VICENTINI and PACHER states that they found distinct evidence of an irregular reflection from a parabolic brass mirror but none from a similar glass mirror; a list of substances is given in the abstract, showing their relative transparencies; they conclude that there appears to be no clear relation between opacity and density.

S. P. THOMPSON. *L'Eclairage Elec.*, April 18; a reprint of an academy paper from *Comptes Rendus*, April 7.—He describes a number of observations which he made. He finds that the best material for the fluorescent screen is black cardboard covered with a thin layer of very finely powdered potassium platino-cyanide, which is at least 12 times more luminous than the barium salt used by Röntgen; among other materials which he tried and found inferior was tungstate of calcium; he used tubes in which the cathode rays are concentrated on a central disc which then becomes the source of the X-rays; he calls this piece the anti-cathode; for this he used with success discs covered with a phosphorescent enamel composed of sulphide of calcium and the ordinary transparent enamel; with such a tube 40 seconds is sufficient for photographing the hand; he prefers a Ruhmkorff coil, as the Tesla coil heats the tubes too much without increasing the useful effect and the photographs are not so sharp on account of the existence of the two sources of rays. He describes the action of the tube while it is being exhausted, and finds by means of a parallel spark gap that a point is reached at which the resistance increases suddenly and it is at that moment that the tube is most efficient in producing X-rays; if the vacuum is pushed too far the resistance increases, so that the tube becomes almost a non-conductor, but it will nevertheless be

operative if the voltage is increased sufficiently. With the aid of the screen one can also notice the heterogeneity of the rays; for a moderate rarefaction the rays do not penetrate the flesh to the exclusion of the bones, as do the rays which are produced when the vacuum is increased; if however the vacuum is too high the rays traverse not only the flesh but the bones also; there is therefore a certain condition of the vacuum for which the difference between the transparency of the flesh and that of the bones is a maximum.

Chabot. *L'Eclairage Elec.*, April 11.—He endeavored to find by experiment whether the action of the rays on the photographic plate is direct or through the medium of the fluorescence. According to Hoffmans two centres of radiation acting simultaneously on the same object produce no increase of the effect, but on the contrary appear to mutually interfere; according to Zenger, sensitive plates covered with eosine are more strongly influenced; according to Lenard, eosine gelatine does not fluoresce under the action of cathode rays, although it fluoresces strongly under the action of ordinary light. The present writer therefore endeavored to find whether the mutual interference of two primary sources also existed for a primary source and a secondary or fluorescing source; if it does, the increased sensitiveness of the eosine plates would not increase the probability that the action of the Röntgen rays on the sensitive film is due to fluorescence. He tried an experiment by placing three different glass tubes next to each other, on which were laid two small spheres of lead, and submitted them to the action of the rays for 15 minutes, after which the lead spheres were removed and the glass tubes covered with a sensitive plate, in one case immediately afterwards and in the second case after 10 hours; the images which were formed showed clearly the place where the two spheres were. His experiment leads him to hope that it might be possible to make superficial images by means of Röntgen rays if the objects phosphoresce.

L'Ind. Elec., April 10; Academy papers.—Besides those abstracted above there is one by Piltschikoff, in which he showed that by using a Puluj tube and a Wimshurst machine he made photographs in 2 seconds; he also showed that "electrostatic actions" had no influence on X-rays. Bleunard and Labesse showed that the opacity of bodies seemed to increase with the atomic weights of the salt solutions of metals and metaloids. this was applied by writing characters with ink containing bromide of potassium, which, when the paper was enclosed in an envelope, could be photographed so as to be easily read. Buguet and Gascard showed that corundum, ruby, sapphire, emerald, topaz, torquoise and cat's-eye can be distinguished from their imitations; small, fine pearls are less opaque than their imitations; with large ones the distinction is not so decided. Wuillomenet showed that although the material of the eye was not translucent to the rays, yet a shot introduced into the eye is easily seen; the experiments were made with the eye of a rabbit; repeating them with the human eye gave negative results in spite of the use of intense rays and a prolonged exposure. Gouy stated that in heating the Crookes tube, which had been in use, it appears to become dull, the alteration occurring on the interior surface; this was greater the more intense the cathode rays had been; the microscope shows this to be formed of minute bubbles of gas near the interior surface; by sufficient heating these bubbles combine and may then be seen by the naked eye.

Dr. Dorn, in the *Elec. Zeit.*, April 16, states that it is unlikely that the Woodward "lamp" (see The Electrical World, F2b. 29,) could remain disconnected from the air pump for any length of time; he therefore tried to make one by covering the open end of a tube with a cemented cap of aluminum but it also leaked; he has since fused an aluminum cap in the glass and expects better results therefrom. He states that the Röntgen rays started from that portion of the tube on which the cathode rays strike most densely; fluorescence of the glass, however, is not necessarily connected with the production of Röntgen rays; sometimes there will be dark spots in these fluorescing places, due to inequalities of the glass, but they are also sources of Röntgen rays.

Dr. Kalischer, in the same journal, states that Geissler tubes will give forth Röntgen rays when they are connected with the wires of the Lecher arrangement for demonstrating Hertsian oscillations; he is making experiments with a view to increasing the intensity of the action; (from which it may be figured that the action is weak).

The Lond. *Elec. Eng.*, April 17, states that according to a letter of Mr. Espin, in "photographing pieces of zinc, tinfoil and silver with a screen of calcium tungstate before the plate the rays are shown to have penetrated them. With a screen of barium-platino-cyanide the images appear." It is thought that this points to the existence of something equivalent to undulations of different periods being contained in the Röntgen rays.

Invisible Radiations Emitted by Uranium Salts. Becquerel. *L'Ind. Elec.*, April 10; abstracts of two Academy papers.—In a previous paper he stated that these radiations have the property of discharging electrified bodies; in the first of the two present papers he shows by means of photographs that these radiations traverse opaque bodies, particularly aluminum and copper, while platinum absorbs much more than these metals; he gives some data regarding the absorption of these rays through a slab of quartz. In the second paper he shows the difference between these and the Röntgen rays; considering absorption alone, these two kinds of rays act as though they have different wave lengths; but the absence of reflection and refraction of the Röntgen rays shows a greater difference; it is probable that the phosphorescence of the anti-cathodic spot is only a concomitant phenomenon of the electric phenomenon, and that it is this electric phenomenon which produces phosphorescence in the photographic plate, which in turn acts on the silver salts; phosphorescence of the glass on the bulb may be accompanied by radiations like those emitted by uranium salts, but it is probable that a very long exposure would be necessary to prove this.

Conditions of Maximum Power of Crookes Tube. Chappuis and Nugues. *L'Eclairage Elec.*, April 18; reprinted from *Comptes Rendus*, April 7.—They find that the power of the tube does not increase with the number of breaks, the current being kept the same on closed circuit; they found that there is a maximum effect for about 10 breaks (presumably per second); they found that the effect on the tube is an instantaneous one, like the discharge which produces the fluorescence, and from this it would seem that the power ought to be proportional to the number of discharges; there are therefore two phenomena which vary inversely with each other, both of which should be noticed in order to get the maximum effect; this maximum depends on the self-induction of the coil.

Mechanical Action from Crookes Tubes. Rydberg. *L'Ind. Elec.*, April 10.—He repeated the experiments of Gossart and Chevallier with the action of Röntgen rays on the Crookes radiometer (see *Digest*, March 28) and arrived at the conclusion that the phenomena noticed are due to the influence of the layer of positive electricity at the exterior surface of the tube, on the metallic vanes of the radiometer, and has nothing to do with the Röntgen rays.

New Kind of Ray in Sparks. Wiedemann. *Jour. Inst. Elec. Eng.*, April; abstracted from the *Beiblaetter*, Vol. 19, No. 10.—If different substances are subjected to the action of electric sparks at a distance of two to four cm and afterward heated they are seen to phosphoresce; he shows that this is not due to ultra-violet rays, as supposed by Becquerel, but that it is caused by a new kind of ray of an uncertain nature which he calls "discharge rays;" they are similar to cathode rays but are not deviated by magnets; they are readily detected by their action on sulphate of calcium containing a trace of sulphate of magnesia, also several other substances named; a part of these substances should be covered with quartz or fluor spar; on heating, the uncovered part fluoresces; fluor spar is therefore not transparent to these rays and air does not absorb them. (See also abstract in the *Digest*, Aug. 31, 1895.)

Condenser Oscillations. Topler. *Jour. Inst. Elec. Eng.*, April; abstracted from the *Beiblaetter*, Vol. 19, No. 10.—He describes a new method of showing the Hertzian experiments objectively. The multi-plate influence machine produces two distinct kinds of sparks, according to whether the condenser oscillations are transformed up or down; from the former, phenomena are obtained which have not before been observed with electrostatic appliances; but when transformed down, most of the Tesla experiments can be carried out.

New Influence Machine. Lebiez. *Jour. Inst. Elec. Eng.*, April; abstracted from the *Beiblaetter*, Vol. 19, No. 10.—The theory of this machine is similar to that of Lord Kelvin's replenisher. The machine consists of a stationary disc of glass, on the outside of which are fixed two sectors of tinfoil; at a small distance from this disc is fixed a thin movable disc of ebonite on which are pasted a number of radial sectors; in front of the movable disc is placed an ebonite rod carrying two ball-shaped exciters, and to these are fixed two U-shaped conductors, which surround both discs, and also end in balls which are respectively connected to the tinfoil layers of the fixed stationary disc; the exciting balls carry small brushes of Dutch metal making contact with the sectors of the movable disc; there is fixed on the axle a non-insulated movable neutral conductor carrying brushes at its ends; the machine cannot change the sign of the charge, and is specially adapted for producing long sparks. The abstract contains no further description.

Simple Method of Analyzing Periodic Curves. Wedmore. *Jour. Inst. Elec. Eng.*, April.—A reprint of a Student's paper describing the principle and application of a method, together with the analytical and graphical proof of it. The method consists of a continual application of the following process: "Draw the curve so that the independent variable, say time, is horizontal; divide the curve vertically into any number of equal parts; superpose these parts and algebraically add them."

Experimental Researches to Determine the Origin of Frictional Electricity. Christainsen. *L'Eclairage Elec.*, April 18, abstracted from the *Wied. Ann.*, Vol. 53, page 401; it is followed by a second abstract of an article by the same author on the origin of contact electricity, from *Wied. Ann.*, Vol. 56, page 644.

Theory of Electricity. Vaschy. *L'Eclairage Elec.*, April 4.—Beginning of a serial of a mathematical character.

Vacuum Pump. Raps. *Elek. Zeit.*, April 16.—An illustrated description of a mercury pump which is said to be extremely simple and is capable of producing the highest vacuum in a very short time, and the operation of which is very reliable; a space of 400 cb. cm can be exhausted in 5 to 6 minutes down to 0.001 mm and a space of about 4 liters to the same degree in about half an hour.

Resistance of Conductors to Alternating Currents. Brylinski. *L'Eclairage Elec.*, April 11.—A reprint of the article noticed in the *Digest*, March 28.

Resistance of Conductors to Alternating Currents. MASCART. *Jour. Inst. Elec. Eng.*, April.—A full abstract of the article noticed in the *Digest*, Feb. 8 and Jan. 18.

Effects of Annealing, on Magnetic Homogeneity. EBELING and SCHMIDT. Lond. *Elec.*, April 17; abstracted briefly from the *Zeit. fuer Instrumentenkunde.*—It has not yet been clearly established whether the lack of uniformity in different samples of iron and steel is inherent or is remediable by sufficient annealing, and the researches described were therefore undertaken to determine the efficiency of thorough annealing in rendering iron magnetically homogeneous. Tests of many samples showed that homogeneity was very rare; the samples were annealed in a furnace, the maximum temperature of which was nearly 1000 degrees C., and were left there for about fifty hours; after this the metals were found to be much softer and the hysteresis loss was considerably reduced, in their uniformity, however, the results differ in the various specimens; wrought iron was no more homogeneous than before ; wrought steel (tungsten) was much improved; rolled iron was hardly changed, but it was from the first fairly uniform; cast steel, which was usually very uniform, showed, after annealing, a slight variation in its different parts. They concluded that while thorough annealing is beneficial it cannot be relied upon for eliminating want of uniformity; also that carefully prepared cast metals are more likely to be homogeneous than wrought metals.

Magnetic Homogeneity and Electric Conductivity. EBELING. Lond. *Elec.*, April 17; abstracted briefly from the *Zeit. fuer Instrumentenkunde.*—He made experiments to ascertain if there is any direct relationship between the magnetic and electric properties of iron; samples of iron and steel were tested magnetically and for conductivity; the results of some 20 pieces indicate that those iron and steel rods which show small differences in conductivity are also magnetically non-homogeneous; "to the converse statement that all magnetically homogeneous materials also possess uniform conductivity, there are, however, exceptions."

Magnetic Properties of Pyrrothine. ABT. *Jour. Inst. Elec. Eng.*, April; abstracted from *Wied. Ann.*, Vol. 57, page 135.—This mineral, which is a sulphate (sulphide ?) of iron has magnetic properties comparable with those of magnetite; it can be artificially magnetized and retains a large portion of the magnetism; artificially cut prisms are far less magnetic than magnetite; its coercive force is greater than that of magnetite.

Vertical Earth Electric Currents. REUCKER. *Proc. Lond. Phys. Soc.*, April; a reprint of his complete paper.

Magnetographs. MCKAY. *Sc. Amer.*, April 18.—An image of an object will be formed if placed on the sensitive film of an ordinary photographic plate when the poles of a magnet are held for some time on the other side of the plate; a number of such impressions are shown; the objects must be para-magnetic. If the plate is placed with its sensitive side toward the magnet and an iron plate is placed on the opposite side "shadowgraphs" of any non-magnetic or diamagnetic bodies placed between the plate and the poles of the magnet will be produced; they are said to be as clear and distinct as those produced by the Röntgen rays; he obtained these with a compound steel magnet weighing little more than a pound; the object must be in contact with the sensitive film, a thin sheet of paper seems to prevent the action, or at least diminish it greatly; when an electromagnet is used the process is facilitated by varying or breaking the current frequently; the time of exposure is not a matter of importance; it seems that the action is largely due to approach or removal of the armature or to a change in the current strength; there is no difference between the action of the two poles; conductors seem to be the most opaque substances. He suggests that Röntgen rays may be something analogous to these; and that they may be due to the magnetic component of a Hertz wave.

X-Ray Experiments. FALK. *Elec. Eng.*, April 29.—A note accompanied by some illustrations showing a number of photographs taken with Röntgen rays; he connects only the positive terminal of the coil with the tube, and uses in addition an aluminum reflector around the lamp; a photograph of the human brain is shown. The results are attributed chiefly to the nature of the photographic film, but what this film is is not disclosed; it is stated that between the object and the tube there is a sheet of tinfoil with a number of wires attached to it and to the negative terminal; a sheet of bright tin is placed in back of the object; the exposure was seven minutes; a dark spot on the photograph of the brain is said to correspond with a point where the subject was struck several years ago.

Röntgen Rays. MORTON. *Elec. Eng.*, April 29.—A brief description of a number of experiments which were described years ago relating to phenomena connected with the subject of Röntgen rays. Rood, in 1864, described making photographs with the light from Geissler tubes; Stokes, in 1852, showed that some solids and solutions had the power of absorbing light of various wave-lengths and emitting them again with an increased wave-length; it was known that certain practically invisible rays could produce visible effects by fluorescence. Profs. Rood and Mayer recently demonstrated absolutely that X-rays are not capable of being polarized.

ELECTRO-CHEMISTRY AND BATTERIES.

Indirect Electrolysis. ANDREOLI. *Jour. Inst. Elec. Eng.*, April; abstracted from *L'Eclairage Elec.*, Vol. 6, No. 1.—After a brief description of indirect electrolysis (*Digest*, Aug. 23, 1895, and March 28, 1896) he states that in one of his experiments the two outside compartments were filled with a solution of salt and the centre compartment with a solution of cyanide of gold, the anode being retort carbon and the cathode iron; he found that the gold solution was not altered by the passage of the current; if metallic plates are placed in the middle compartment they become coated with gold and the solution is exhausted, but is not contaminated with either chlorine or soda. In a single experiment all three compartments were filled with the gold solution, the anode being lead and the cathode iron; after seven days the composition of the liquids in the end compartments was found to be the same as at first, and there was no gold on the cathode, although nearly 100 litres of the gold solution had been exhausted during this time in the middle compartment. In another experiment he transformed bisulphite of sodium into hydrosulphite of sodium in the centre compartment, like in the first experiment described. Under certain conditions this electrolytic process, he claims, presents a marked advantage over the ordinary process.

Electrolysis of Chloride Solutions. ANDREOLI. *Jour. Inst. Elec. Eng.*, April; abstracted from *L'Eclairage Elec.*, Vol. 6, No. 2.—He claims that it has been practically demonstrated that hypochlorites, as produced by electrolysis, are of little value, as nearly the whole of the chloride solution is left undecomposed in the hypochlorite; the solution can scarcely be used again, as it is so charged with organic substances; hypochlorites cease to be of practical value unless a method is discovered for producing at least three grams of chlorine per litre. He then gives a brief description of several of the processes for the production of chlorine and soda.

Electrolysis of Hydrochloric Acid Without a Membrane. OTTEL. *Jour. Inst. Elec. Eng.*, April; abstracted from the *Beiblaetter*, Vol. 19, page 11.—Ordinarily the production is considerably below the calculated value as the chlorine is dissolved; the best results are obtained from a concentrated solution of brine and sulphuric acid; with an increase of the electrolysis the pressure rises, commencing at 1.8 volts and rising to 3.7.

Electrolysis of Chloride of Sodium. FOURIER. *L'Elec.*, April 11 and 18.—A description and discussion of the Castner and Hargreaves processes.

Cyanide Processes. Lond. *Elec. Rev.*, April 17.—The beginning of a review of "the great cyanide case in the Transvaal," of which the result is expected to be made public soon.

Separating Tin From Tinned Iron. CLAUSS and SUTTON process. *L'Eclairage Elec.*, April 4.—The scrap is made the anode in a bath of one part of sulphostannate of sodium with two parts of water, heated to 90 degrees; the current is 100 amperes per sq. meter; the tin is deposited on the cathode and the other metals on the anode, with the exception of arsenic and antimony, which are precipitated as sulphides; if the tin contains a little antimony or arsenic it can be treated in an acid bath containing hydrochloric acid and hyposulphite of soda, in which these impurities are precipitated as sulphides; no further information is given.

Nature of Chemical Change and the Conditions Which Determine It. ARMSTRONG. Lond. *Elec. Eng.*, April 17.—The beginning of a reprint of his presidential address to the Chemical Society; he bases his theories on electrolysis.

Weight of Solution in Accumulators. FITZ-GERALD. *Jour. Inst. Elec. Eng.*, March.—A brief communication giving formulas for calculating the weight of the dilute acid to be allowed in the construction of accumulators, knowing the effective capacity and the rate of discharge; an extract is published in the Lond. *Elec. Eng.*, March 13, and a correction of the formula in the next issue.

Theory and Construction of Secondary Batteries. ZACHARIAS. Lond. *Elec.*, April 17.—A translation of the article abstracted in the *Digest*, April 4.

Construction and Theory of Lead Batteries. LOEBB. Lond. *Elec.*, April 17.—A translation of the article abstracted in the *Digest*, April 4.

Electrodynamic Theory of the Gas Battery. QUINCKE. *Zeit. f. Elek.*, April 1.—A brief abstract from a recent paper giving the electrodynamic theory of a gas battery in which carbon monoxide is converted into carbon dioxide.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electricity Supply Meters. RICKS. *Jour. Inst. Elec. Eng.*, March.—A reprint of an Institution paper read at a students' meeting, in which he gives brief illustrated descriptions of a number of more prominent meters and discusses the question of the cost including that of the energy absorbed; this cost may be divided into two parts, one the initial cost of the meter and the other the continuous cost, which is that of the energy which is continually being absorbed; besides this there is the depreciation; no conclusions of any particular value are given.

Meter for Accumulators. ALIAMET. *L'Elec.*, April 18.—An illustrated description of an Aron meter, which is constructed specially for accumulator installations and will register separately the current in each direction, that is the charging and the discharging currents, using only a single mechanism.

Potentiometer. KOLLERT. *Elek. Zeit.*, April 16.—An illustrated description of a form of apparatus which it is claimed can be constructed by simple means and at small cost, and may be used for accurate voltage and current measurements, as also for measuring resistances and calibrating galvanometers.

Capacity and Resistance of a Core with Eccentric Conductor. Lond. *Elec. Rev.*, April 17.—A brief, illustrated description of a method of experimental determination, referring apparently to the cores of submarine cables; the description is not clear.

Transmission Dynamometer for Measuring the Power Absorbed by Machines. Eng. News., April 23.—A brief, illustrated description of a new form.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Size of Multiple Switchboards. Hesse. *Elec. Zeit.*, April 16.—He gives the reasons why the number of switches on switchboards cannot be increased to 20,000 or 25,000; he does not consider the increased first cost of a large station as compared with the total cost of a number of smaller ones, but limits himself to the construction of the board. He concludes that for a horizontal board the practical limit is reached at about 12,000 with the present system; to increase this number would be objectionable and would be likely to cause interruptions; he favors the horizontal board in preference to the vertical one, and states that the first cost of a station with the former is about one third less than of one using the latter.

Long-Distance Telephony. Baradat system. *L'Éclairage Elec.*, April 18.—A reply by Baradat to the criticism made by Hesse (see *Digest*, Dec. 7) to the description of the system (see *Digest*, Nov. 9). It is followed by a further reply by Hesse. (The general principle of this system is that the problem should be treated like that of a transmission of power to a great distance by alternating currents.)

Automatic Night Telephone Service. Zielinski. *L'Eclairage Elec.*, April 18.—A French translation in abstract with some of the illustrations of the description noticed in the *Digest*, March 28.

Safety Device for Telephone Circuits. Mertsching. Lond. *Elec.*, April 17.—A translation in abstract with the illustrations of the article noticed in the *Digest*, April 18.

Telephone Exchanges and Their Working. Lond. *Elec. Eng.*, April 17.—The beginning of a reprint of the discussion of Mr. Sinclair's recent Institution paper.

Gear for Japanese Cable Steamer. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng*, April 17.—An illustrated description of the gearing for operating the cable on the *Okinwa Maru.*

MISCELLANEOUS.

Insulating Material for Wires. L'Elec., April 4.—Anderson, of Stockholm, makes an insulating material by treating a fatty oil, such as resin oil, with 20 to 30 per cent. of concentrated sulphuric acid at a low temperature; to this is added cellulose or moistened cotton; this is heated to 110° C., and pulverized sulphur is added, which is followed by a reaction which completely changes the consistency of the material; to this is added a large quantity of sulphur and it is then poured into cold water, after which it is rolled between cylinders and combined with rubber, gutta percha, resin or paraffine, according to the purpose for which it is to be used.

Miscellaneous Apparatus. L'Eclairage Elec.—The current numbers contain an illustrated description of the electrical apparatus at the present exhibition of the French Society of Physics.

Calcium Carbide and Acetylene. Jacquin. *L'Eclairage Elec.*—A series of articles in the current issues.

Ozone Generator. Elec. Eng., April 29; a reprint from *La Nature*, of an illustration and a brief description of the Seguy ozone generator, which is operated by electric motors and is said to furnish nine cubic metres per hour of ozonized oxygen, "that is, about 14 to 20 milligrammes per litre."

New Book.

University Physics. Part II. Heat, Electricity and Magnetism. By Henry S. Carhart, LL. D. Allyn & Bacon, Boston. 446 pages; 224 illustrations. Price, $1.50.

This volume has been written in pursuance of the plan outlined in Part I., and the same method has been followed as far as practicable. Of its 26 chapters, 10 are devoted to the subject of heat and 25 to electricity and magnetism. The treatment of the various subjects is very clear and concise, and the problems given at the end of each chapter will enable the student to acquire a wide knowledge of the practical application of the lessons taught. The book bears evidence of care having been taken in its production; it is well printed, and the illustrations, many of which are original, are very clear and well executed.

The work has the merit of being thoroughly up to date, and is entitled to the distinction, we think, of being the first publication in book form to touch upon or in any way refer to the now famous discovery of Prof. Röntgen. The subject is treated under the head of "Cathode Rays," and while this title is now generally considered inappropriate, the subject-matter suffers nothing in consequence. Dynamos and motors of every class receive proper treatment, and the book concludes with a chapter on the researches of Hertz, Faraday and other investigators in electric oscillations and waves.

To Visit the Crocker-Wheeler Factory.

The Crocker-Wheeler Electric Company has issued an invitation to the delegates to the convention to visit their works at Ampere, N. J., on Thursday evening, May 7. A special train will convey the party to the works, leaving New York at 8.10 o'clock. The train boat leaves the Barclay Street slip at the hour named. Special cars will be reserved for ladies. The train will leave Ampere on its return to New York at about 10.15 p. m.

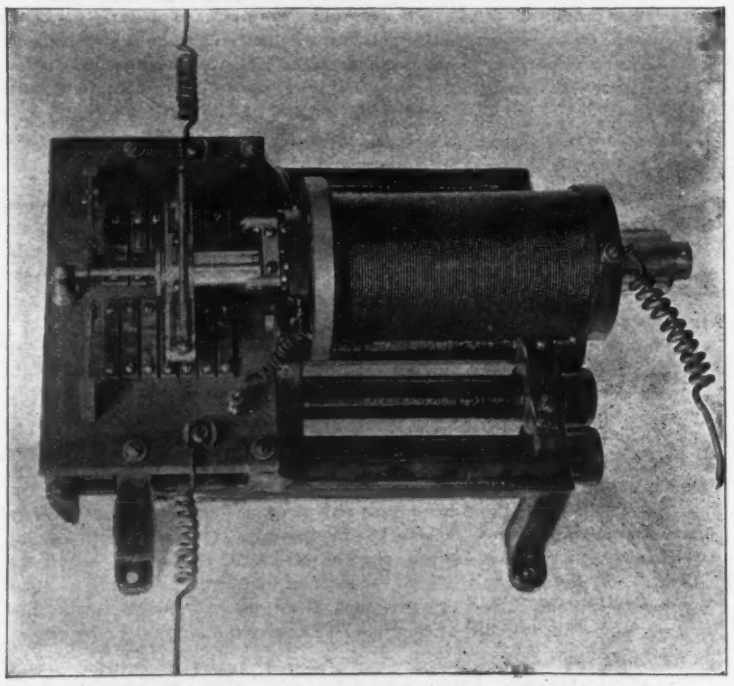
Gov. Morton's Escort Committee.

President C. H. Wilmerding, of the National Electric Light Association, appointed a committee to go to Albany on Monday to escort Gov. Morton to New York to attend the ceremony of opening the Electrical Exposition at 8 o'clock Monday night. The committee consisted of M. J. Francisco, Judge E. A. Armstrong, James I. Ayer and Charles R. Huntley These gentlemen left New York at 10.30 a. m., Monday, in President Depew's private car on a special train. The party, with their distinguished guest, returned to New York in the early evening.

Automatic Motor Starter.

The latest development in automatic motor starters is shown in the accompanying illustration. It is brought out by the Automatic Switch Company, of Baltimore, Md., and combines the remodelled working parts of this company's Whittingham solenoid starter and tubular fireproof resistance.

The size of the apparatus has been much reduced by placing the dashpot and plunger inside of the solenoid, and the direction of movement allows the use of compression instead of suction control.



Automatic Motor Starter.

Renewable carbon brushes engage heavy copper contacts, while carrying the starting current, and a substantial metallic circuit is closed when all the resistance is cut out.

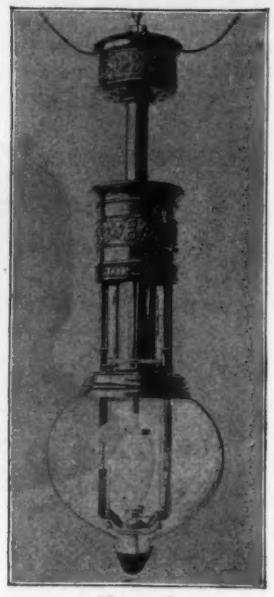
This apparatus will be found of great service wherever it is desired to start a motor automatically from a distance, as in elevator pumping and similar installations.

New Long-Burning Arc Lamp.

Arc lamps for constant potential continuous circuits, designed to burn 150 hours without retrimming, and shorter lamps of similar design, to burn 100 hours without retrimming, have just been announced by the General Electric Company. These lamps require about 5 amperes at 80 volts, a resistance adjustable for voltages of 105 to 120 contained in the lamp reducing the normal voltage of a lighting circuit to that required by the lamp. The lamps are sent out adjusted for 110 volts. By confining the arc in a sealed globe an inert gas is formed reducing the consumption of carbon, and securing longer life. The mechanism of the lamp is simple, requiring no adjustment.

The color, volume and character of the light is varied by using different inner and outer globes. A dense opal inner globe and opalescent or ground glass outer globe gives the effect of the glow lamp, with less vol-

100-HOUR LAMP.



150-HOUR LAMP.

ume of light, while where the appearance of the light is not objectionable an opalescent inner globe and a clear outer globe may be used, securing a larger volume of light.

A New Lathe.

We present herewith a cut of a new polishing lathe recently put on the market by the Diamond Machine Company, of Providence, R. I. It is designed to carry either solid leather wheels, wood wheels covered with leather, or buff wheels. As will be seen from the cut, the lathe has a heavy, substantial head, with extra long bearings, and an overhanging arm which gives great strength and stiffness. The boxes are protected from the entrance of emery or other dust. The column is hollow, and of sufficient size to permit the machine to be belted from a countershaft running below the floor. The head is mounted on a short column for bench use if desired, but the cut shows the machine as a foot lathe. The boxes are babbitted with the best metal. The spindle may be provided with

POLISHING LATHE.

either a single tight and loose or a cone pulley. The machine is designed to meet the requirements of manufacturers who desire a first-class lathe at a moderate price. The spindle is 48 inches long, 1½ inch diameter in the boxes and 1¼ inch between flanges. The entire weight is about 400 lbs.

Electric Locomotive.

The General Electric Company has shipped from the Schenectady works the last of the three great electric locomotives for the operation of all trains on the mainline of the Baltimore & Ohio Railroad. These locomotives will handle the entire freight and passenger traffic of the Baltimore & Ohio road passing in and out of Baltimore from the North, through the Belt Line tunnel, which passes under the city and which is the longest soft earth tunnel in the world.

Each locomotive weighs 96 tons, and while almost equal in size to the largest of steam locomotives, greatly exceeds one of these in power, being capable of developing 1500 horse-power.

The first was put into service in August last and the second in December, since which date they have been handling the entire freight traffic of the Baltimore & Ohio road through the tunnel without accident of any kind.

The arrangement of the controlling levers in the cab has been made as like that of the steam locomotive as possible, and the engineer accustomed to the latter has but to pull a lever to start his electric engine with the same ease as he formerly did his steam locomotive.

In appearance these gigantic electric machines resemble a large locomotive cab with sloping shield fore and aft. The cab contains the controlling mechanism and the shields enclose the air compressors and tanks.

We are informed by the General Electric Company that no limit in speed has yet been reached with these locomotives, 80 miles an hour having been attained without effort, and that they could as easily make 150 miles an hour as the steam locomotive makes 60.

As soon as the third locomotive reaches Baltimore it will be assembled and placed on the tracks. The locomotives will then undertake the passenger service as well as the freight traffic, and the present coke-burning engines drawing the passenger trains will be shut off before entering the tunnel.

A New Gas Engine for Electric Lighting.

Jacob Brombacher Sons have just perfected and are about to put on the market a new gas engine for electric lighting. The engine has quite an attractive appearance, and, of course, has all the inherent conveniences that any gas engine possesses. In addition, special economy and uniformity of speed which fit it for electric lighting are claimed for it. A card from the engine shows the ordinary cycle of, first, drawing in a charge of gas and air; second, compressing it; third, exploding it, and fourth, exhausting it, these events taking place during two strokes and at full load, therefore one impulse is given at every other stroke. Two large balance wheels serve to accumulate the energy and make the speed more nearly uniform. The valve gear is run by a valve-shaft driven by skew gearing from the main shaft of the engine. It runs parallel to the engine-bed, and terminates at the end of the cylinder. On this end are fixed cams which operate the injection valve, open the ignition chamber and provide motion for the exhaust valve. The engine governs by the process of missing an explosion as the load becomes lighter. An oscillating lever trips the injection valve and on one end of this lever is a weight, which, if the motion is too rapid exerts a downward force, tripping the tilting end of the lever upward and causing it to miss the injection valve. A spring and screw determine the speed at which this governing mechanism shall act and at

GAS ENGINE—ELECTRIC PLANT.

which it regulates the engine. The engine is now being tested at 33 Fulton Street, Brooklyn, by two students of Stevens Institute, Messrs. S. A. Hasbrouck and J. J. Christy, who are using it as their graduating thesis. This test cannot be other than entirely disinterested, and shows a remarkable economy. At one of these tests it was noted that at full load the voltmeter needle had a fluctuation of about one volt, and a corresponding steadiness of the lamps was obtained. Simultaneous readings gave the following results:

Amount of gas consumed per minute, including that used for ignition	3.7 cubic feet
Voltage	110 volts
Current	40.5 amperes

The cost of gas in Brooklyn is $1.25 per thousand cubic feet, and from these it may be figured at once that in this particular case the cost was 6.23 cents per thousand watts or .34 cents per lamp hour. At the time of this test the engine was working under a disadvantage, for the reason that the pressure of the gas system was considerably lower than that at which it normally operates. Numerous runs have been made and careful observations taken, which are open to the inspection of any one who cares to visit 33 Fulton Street. The operations are carried on in a most systematic manner. Messrs. Hasbrouck and Christy have devised a special

arrangement for counting the explosions, so that the exact amount of gas per explosion can be ascertained. This little device is connected with the explosion chamber and provided with a water circulating jacket to keep it cool. The engine, of course, has a water circulating jacket around its cylinder also. The engine drives a jack shaft which is belted to a small Excelsior dynamo. The power is carefully weighed by a suitable power scale at the jack shaft, which was supplied by E. J. Wood, and electrical measurements are taken at the switchboard. Under these exacting conditions it is most probable that whatever merit the engine possesses will be shown from an entirely disinterested standpoint. The tests will undoubtedly speak for themselves, and that the makers of the engine have perfect confidence in their product is evidenced by their desire that the tests and the manner of conducting them shall be open to the inspection of every one. Tests are carried on from 3 to 6 o'clock daily for the benefit of any one who cares to estimate what the running of such a plant costs. Visitors to the Electrical Exposition are especially invited to call and verify the claims that are made for the engine.

Warren Inductor Alternator.

The accompanying illustration represents an inductor alternator manufactured by the Warren Electric Company, Chicago. This type of machine possesses the advantages of employing no moving wire, and neither collector rings nor brushes. The armature coils are fixed, and attached to the inwardly projecting teeth of the stationary but removable armature ring. The outward projecting teeth of the rotor form the path for the magnetic lines through the armature coils and laminated iron ring into the steel frame, thence through the closed end of the frame and across a small air gap into the rotor, thus completing the magnetic circuit.

A single exciting coil is fixed to the inside of the steel frame, supported on an inwardly projecting flange, and so located as to produce an intense field.

The rotor is a cylinder of cast steel, into which the shaft is fitted and forced, and upon the surface of one end, projections are built up of thin sheet steel. The other end is turned smooth and true, and fits into the

Inductor Alternator.

smooth bore of the pulley end of the circular steel frame with a clearance of scarcely a sixty-fourth of an inch. The rotor revolves in an intense field, but has no variation in magnetism, it being always maximum.

These alternators are constructed for either 110 or 220 volts, to be used without transformers, or 1000 or 2000 volts to be used with transformers. In fact, they are adapted to any voltage constructed, and either single-phase or polyphase currents.

Jenney Multipolar Dynamo.

We illustrate herewith the standard multipolar dynamo built by the Jenney Electric Motor Company, of Indianapolis, Ind. This machine is of the six-pole type, and there are quite a number of valuable features of design and construction claimed by the makers.

In the construction of multipolar machines the usual practice is to make the main magnetic frame in two pieces, with the parting on a horizontal line through the shaft. In these machines the parting is on a vertical line, and each half of the field can be slid out on the iron base without any lifting of frame, which would require an overhead hoisting device, and in many locations where there are low ceilings this would be impossible. The sliding surface of the base is extended by means of a temporary iron bracket which is bolted to the base whenever desired. It will be seen that with this construction any of the field coils can be removed without interfering with the armature or other half of field. This point is especially valuable when the armature is mounted on the engine shaft in the case of direct-connected outfits. The magnet cores are made of annealed wrought iron and are circular in form. These cores are forced by hydraulic pressure into massive yokes of cast iron of special mixture. Pole shoes are attached to the wrought iron cores in a very simple and rigid manner, but are easily removed. The screws for sliding the machine on the heavy iron skids are located in the base of machine and extend through the same on one side; this permits the floor being built up to the level of the top of the skids.

The armature core is thoroughly laminated, and no bolts are passed

Six-Pole Dynamo.

through the plates to hold them together, but a very simple set of clamps are used instead. The construction is such that no magnetic lines are cut by the mounting, therefore there is no energy lost from this cause. These armatures are made of both the iron-clad and surface-conductor types. The conductors are all shaped in forms and thoroughly insulated before being assembled on the core. No conductors are allowed to return on the inside of the core, as in the Gramme form of winding.

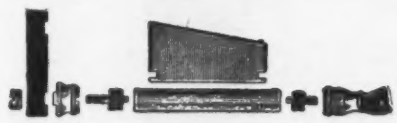
The commutator is of very generous proportions, is thoroughly insulated with mica, is mounted directly to the armature mounting, and does not at any point come in contact with the shaft. These machines are built with either copper or carbon brush-holders, but the makers prefer the carbon, and they make a sectional form of carbon brush-holder that they claim will carry heavy currents with less heat than is usually experienced with carbon.

The shafts are made of steel, and run in self-oiling and self-aligning boxes which are bushed with phosphor-bronze sleeves.

The same care has been exercised in the details of construction of these multipolar machines as has won for this company such a wide reputation on its bipolar generators and motors.

Jack-Knife Switches.

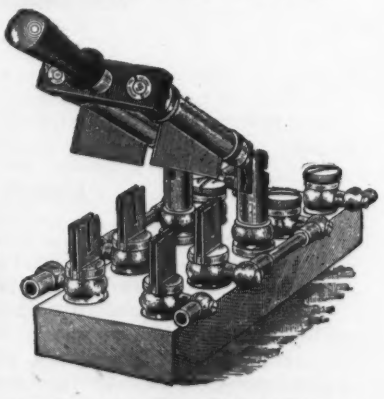
The Electric Engineering & Supply Company, of Syracuse, has brought out an improved jack-knife switch, illustrations of which are given here-



Sections of Arm.

with. The arm is made in sections by a principle which the company has had patented, and which is new as applied to electrical switches. The backbone of the arm is made of brass tube, slotted to receive a copper blade, which is held in place by plugs and nuts, making a secure and

Switch for Back Connection.



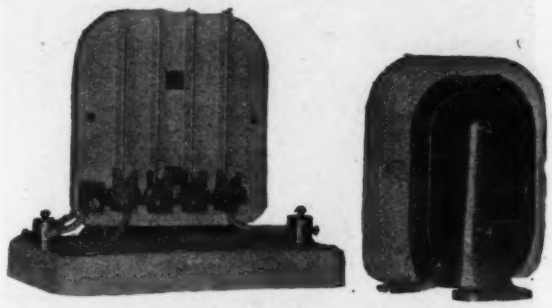
Switch for Top Connection.

strong arm, as well as securing a good flexible contact with the contact clips. A number of these switches are already in use on some of the principal switchboards of New York City, Buffalo and other cities. The

company is now building about 75 of these new style switches, to be placed on the switchboard in the new Siegel-Cooper Building in New York City. These switches are made for either back or top connections, and adapted for any voltage.

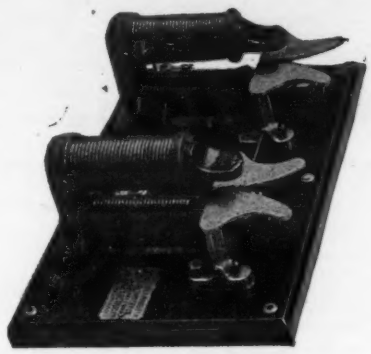
The Magnetic Blow-Out Lightning Arrester.

The function of a lightning arrester being that of relieving excessive potential difference existing between electrical conductors and the earth,



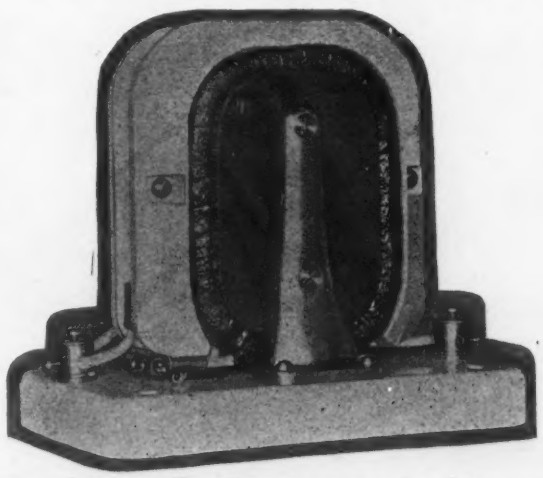
LIGHTNING ARRESTER FOR ALTERNATING-CURRENT CIRCUITS.

while preventing the generator current following the track of an electrical discharge from the conductor to the ground, a perfect device is necessary, and the path of the lightning discharge must be made easy and direct.



INTERIOR CONSTRUCTION OF LIGHTNING ARRESTER.

The Thomson magnetic blow-out arresters for direct-current circuits, whether constant-potential, arc, incandescent, railway or power work, have been already described in these columns. The latest arrester for alternating-current work is known as the type L, and is a development from the well-known type F. It is designed for circuits of 1000 to 3500 volts, and its construction can be readily understood from the illustration. The blow-out magnets have no core, and consist of flat coils placed one on each side of a number of spark gaps, each opening into a porcelain chamber formed by ridges on the inner side of the plates, on the outer side of which are the coils. The gaps are placed in series, and being located at the bottom of the chute, the arc is drawn to the top of the arrester and lengthened by the magnetic field until it can be no longer maintained. In the 1000-volt arrester, shown in the cut, the arc is drawn



A LIGHTNING ARRESTER FOR CIRCUITS OF 100 ARC LAMPS OR MORE.

out to a total length of three feet. For higher voltages the number of chutes is increased.

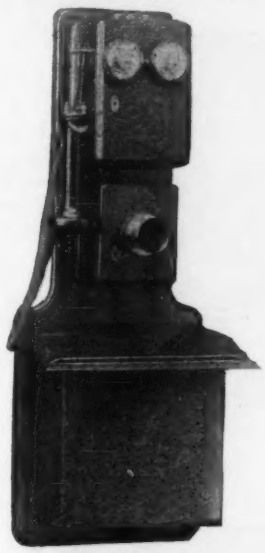
This arrester has been especially designed for use on multiphase circuits from which motors are operated, the requirements being more severe than in ordinary lighting practice. It has already been installed quite extensively in some of the most important plants in the country, effectually performing the duties for which it is designed.

Granular Carbon Transmitters.

The adjustable granular carbon transmitter made by the Hunnings Telephone Company, Elkhart, Ind., embodies features of adjustment by which the instrument can be made as sensitive as desired without taking it apart, or it may be damped for noisy places. By the action of the diaphragm, when the instrument is in use, packing or consolidation of the granular carbon is prevented.

The accompanying illustrations show a desk set and a wall set, as made by this company.

The Hunnings Company manufactures all the apparatus needed for the complete equipment of an exchange, making a specialty of switchboards



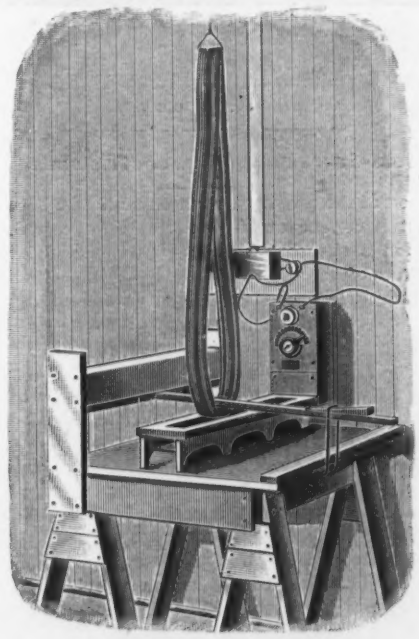
WALL SET.

DESK TELEPHONE.

and combination fuse and testing boards. The boards are covered by the company's own patents, and their operation requires the least amount of work.

Electric Vulcanizer.

The American Electric Heating Corporation, Boston, is pushing an electric vulcanizer for repairing bicycle tires. The vulcanizer gives a uniform and definite temperature for a stated period, which is an essential element in satisfactory vulcanizing.



BICYCLE TIRE VULCANIZER.

The temperature of the plate is controlled by a rheostat or switch on the end of the machine. By turning the switch to successive points, different degrees of heat are applied to the plate.

The device was first put upon the market in August, 1895, and it is

stated that it has met with much favor among leading tire manufacturers.

The electric vulcanizer is made in two sizes, and is easily operated.

New Incandescent Lamp Company.

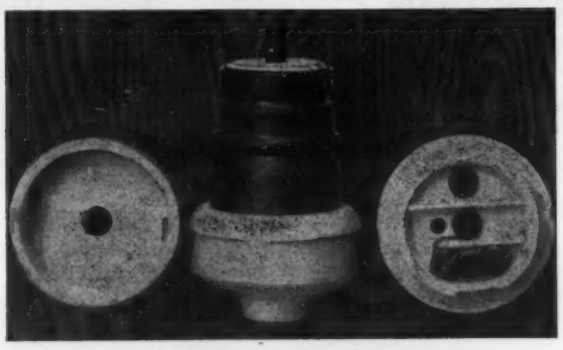
While young in the business of manufacturing incandescent lamps, the Orient Electric Company, of Youngstown, O., has earned for itself a reputation that justifies the pride taken in it. This company claims that the secret of its success lies in the recognition that quality is a much more important factor of success than quantity, and although the company's factory has a capacity of about 2500 lamps per day, yet every lamp is tested with extreme care.

The Orient Company employs skilled workmen in every department, and its factory is equipped with the latest improved machinery and instruments necessary in the manufacture of high-grade lamps.

It has also fitted up a department for the manufacture of a line of porcelain attachment plugs, plain porcelain attachment plugs, enameled wood attachment plugs, and receptacles for miniature lamps, illustrations

Orient Lamp and Receptacle.

of which are shown herewith. These goods are all of the company's own design, and the manufacturers claim for them many advantages over any



Orient Attachment Plug.

other articles of the kind now on the market. Miniature lamps are made in all colors, complete with the receptacles.

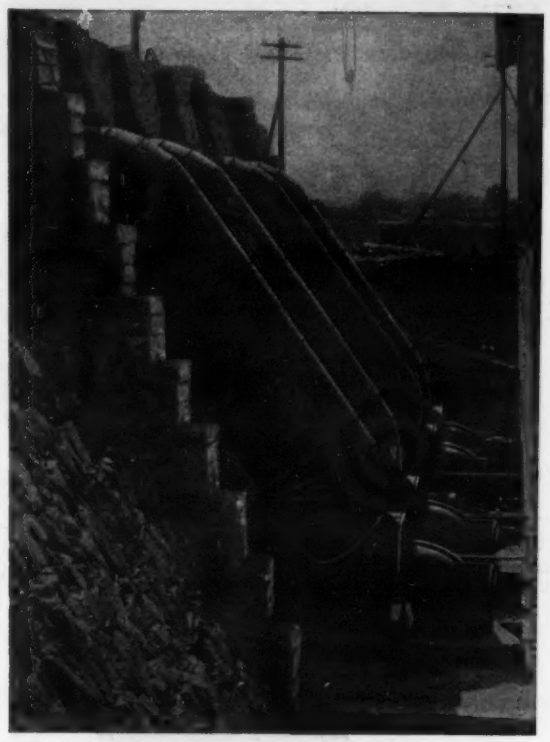
The Folsom-Sacramento Power Transmission Plant.

The completion of the power transmission scheme between Folsom and Sacramento is the conclusion of a vast enterprise, undertaken in doubt and terminated in a success which has demonstrated not only the tremendous resources of the State of California but also the feasibility of electrical transmission over long distance commercially. A preliminary sketch of the progress of the work was given in our issue of April 6, 1895.

The dam is a massive structure of granite laid in Portland cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base, 25 feet wide at the crest, and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard 6 feet high which at high water is lowered into a recess in the crest of the dam. At low water this shutter is raised by hydraulic pistons, the depth of the basin is increased by 6 feet and additional storage capacity provided. Normally the dam forms a storage basin or reservoir 3½ miles long, with a capacity of 13,000,000 cubic yards of water.

At each side of the dam are massive granite bulkheads and three headgates operated by hydraulic machinery, each headgate 16 feet wide. The canal on the West Side, intended principally for irrigation, is not yet completed.

The total length of the East Side canal is 9500 feet. Section 1 is 53 feet wide on top and 45 on the bottom. Sections 2 and 3 are each 50 feet wide on top and 40 feet on the bottom. The depth is 8 feet. All the water passes through the State Power House through Leffel turbine wheels, developing some 800 horse-power, used for air compressors, electric lighting and other purposes. Thence the water continues on to the Folsom Power House, at the side of which is an immense log basin. Here

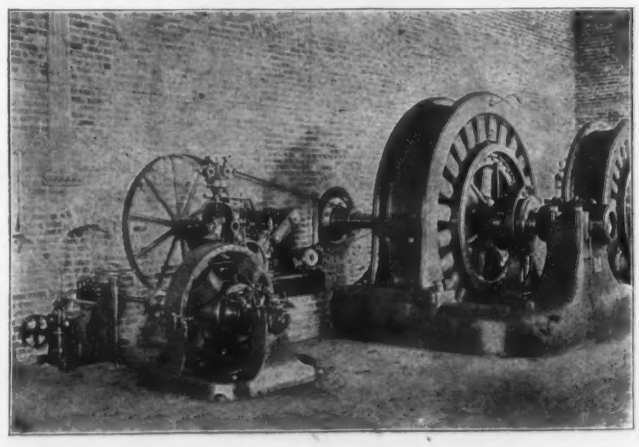


"A" Penstocks and Turbines at Folsom.

the jurisdiction of the Folsom Water Power Company ceases, and that of the Sacramento Electric & Power Company begins.

At the power house the canal makes a sharp turn at right angles and widens out into a forebay, 150 feet long, 100 feet wide and 12 feet deep, which forms a settling basin for debris. The hydraulic apparatus, manufactured by S. Morgan Smith, of York, Pa., consists of four pairs of 30-inch wheels of the McCormick horizontal-shaft turbine type, each pair of 1260-hp capacity at 300 revolutions operating under a head of 55 feet. The steel penstocks are 8 feet in diameter, and each wheel has two draft tubes. The governors are of the Faesch-Picard type, and these are assisted by heavy fly-wheels fitted to the water-wheel shafts. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines is discharged into a tail-race canal which will distribute water for irrigation over the country south and west of Folsom.

The power house is a two-story brick building. The water-wheels are placed in the open air between the forebay and the wall of the structure through which the turbine shafts pass. To each shaft is coupled a 750-kw (1000-hp) General Electric three-phase generator, the largest of their type yet constructed. Each is a 24-pole machine delivering current at 60 cycles 800 volts and running at 300 revolutions per minute. The exciters are 4-pole 500-volt 30-kw generators, either one of which is of sufficient capacity to excite the fields of all four generators. From the generators



Exciters and Governors in Dynamo Room at Folsom.

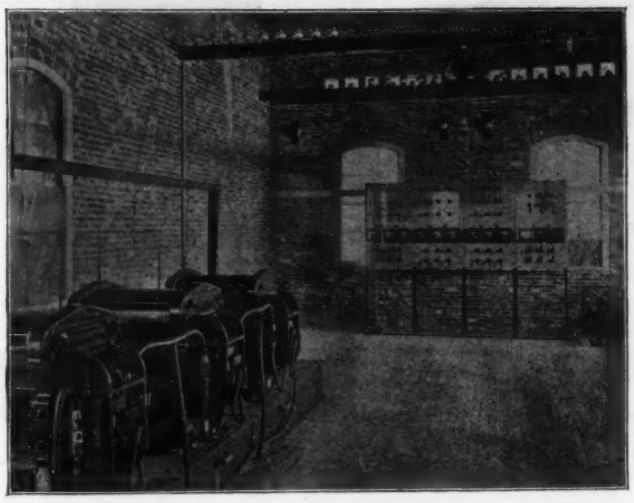
the current passes to the generator switchboard and thence to nine step-up transformers in the upper story of the power house. The capacity of each transformer is 250 kilowatts. They are cooled by an air blast from blowers driven by induction motors. In these transformers the pressure

is raised from 800 volts to 11,000 volts and the current passes to the high-tension transmission lines carried out of the power house through porcelain-lined holes in the wall.

The switchboards are of Tennessee marble, and are so arranged that the generators may be run in parallel or on separate lines as may be desired. The generator switchboard carries the necessary switches, instruments and other apparatus for synchronizing the generators. The boards in the transformer room carry switches for the high and low tension sides of the transformers, and switches and current indicators for the transmission lines.

The pole line is double throughout, and follows the highroad from Folsom to Sacramento, a distance of 24 miles. Each pole carries two cross-arms for two circuits, each circuit consisting of three bare copper wires supported on double-petticoated porcelain insulators, especially designed and made for this installation at the porcelain factory of the General Electric Company at Schenectady. Each insulator before shipment was exposed to a test of not less than 25,000 volts, alternating. The loss is calculated to be 7.5 per cent. when transmitting 3000 horse-power.

The telephone line is carried on the same poles as the transmission line, and connects the power house with the sub-station in Sacramento. The transmission lines being spiraled every mile, and the telephone wire



AIR BLAST EQUIPMENT AT FOLSOM.

transposed every fifth pole, no induction is noticeable on the telephone circuits and conversation is not in any way interfered with.

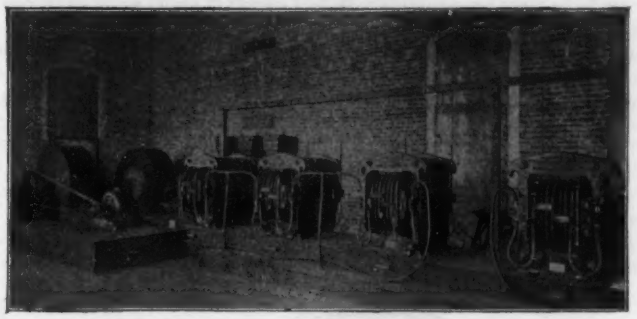
The sub-station is a fireproof two-story brick building on the corner of Sixth and H Streets, Sacramento, having the transformers on the second floor and the dynamo room on the ground floor. In the transformer room the high-tension switchboards receive the terminals of the 10,000-volt lines and operate the different combinations of the step-down transformers. These transformers, also ventilated by blowers, vary in size according to the duty required of them, the secondaries delivering current at 125, 500 and 1000 volts. They number twenty-one—15 of 125 kilowatts and 6 of 40 kilowatts.

The transformers are connected to high and low-tension switches on the boards, and from these the current passes to the distributing boards for the synchronous motors, power circuits and incandescent lighting.

In the main or dynamo room of the sub-station a line shaft runs the entire length. To this are directly coupled, through friction clutches, three synchronous motors, each of 250-kw capacity, wound for a potential of 500 volts and run at a speed of 450 revolutions. To the line shaft are belted one 200-kw and one 90-kw multipolar General Electric railway generators and two 100-kw Edison bipolar machines, all of 500 volts, and three 100-light and two 75-light Brush arc machines.

In this room are also the switchboards for controlling the synchronous motors, the railway generators and circuits and the arc dynamos.

For the operation of the synchronous motors 750 kilowatts of transformer capacity is utilized, the balance being used for low and high-tension distribution. The low-tension current is distributed by a three-phase four-wire system, combining the three-phase and Edison three-wire systems, *i.e.*, three wires for the three-phase current and a fourth or neutral wire. Incandescent lights are connected between the neutral and any one of the three other wires, while motors are connected to the three-phase wires, giving at the mains 115 volts for lamps and 200 volts for motors. The feeders for this extensive system pass from the sub-station through a distributing switchboard, which carries potential regulators for maintaining constant pressure at the mains. Additional circuits run



STEP-UP TRANSFORMERS AND OUTGOING WIRES AT FOLSOM.

from the sub-station at 500 and 1000 volts, supplying current for lights and motors in the more distant parts of the city.

Power was transmitted for the first time from Folsom to Sacramento, on July 14, 1895, for the operation of the Sacramento Street Railway.

The power transmitted is now being used for manufacturing purposes,

STEP-DOWN TRANSFORMERS AT SACRAMENTO.

as well as for lighting the city and running the street railway. Among the establishments now using the power are flour mills, box factories, machine shops and hotels.

The entire equipment was carried out by the General Electric Company whose apparatus is exclusively employed.

This plant is a complete illustration of the possibilities of electric transmission, every problem to be met with in transmitting power over long distances at high potentials and utilizing it having been solved successfully.

DYNAMO ROOM SUB-STATION AT SACRAMENTO.

"Hub" Anti-Friction Ball-Bearings.

As nearly every one knows, considerable power is lost at the bearings of operating machines of all kinds, and to reduce this loss to the lowest point has always been one of the problems in mechanics. All sorts of devices have been brought out with this object in view; some have utterly failed and others have met with different degrees of success.

Ball-bearings have become recognized as among the most efficient means of reducing friction losses to a minimum, and exhaustive tests have demonstrated that by their use the friction is less than one thirtieth of that developed by the best class of ordinary bearings now in use.

The accompanying illustrations show two types of ball-bearings made by the Ball-Bearing Company, Boston, Mass.

Type A, single radial bearing, is shown in Fig. 1, and type C, single end-thrust bearing, is illustrated in Fig. 2.

The type A bearing is designed for moderate loads and consists of one each, sleeve, cage and facing, and of a cast-iron box in which the parts

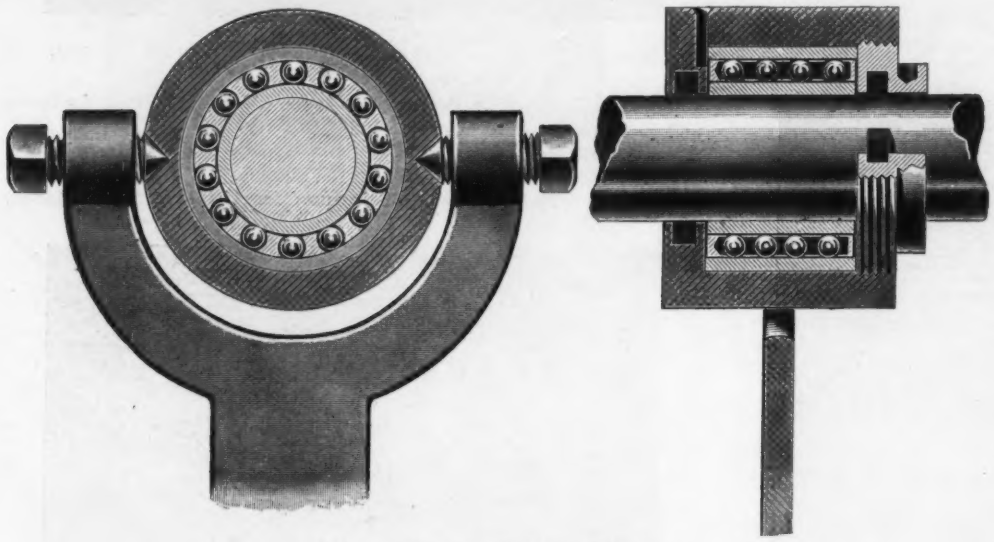
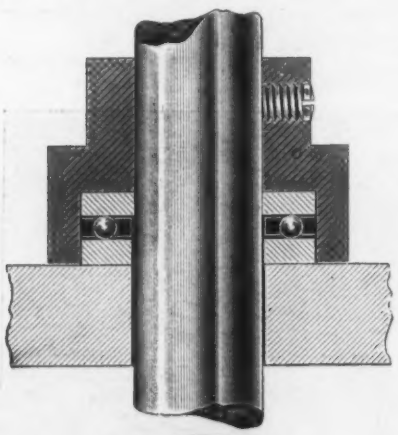
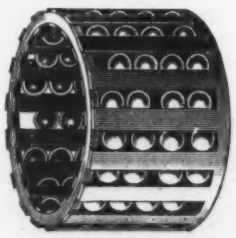


Fig. 1.—Single Radial Bearing.

are retained by a shoulder at one end, and by a threaded holding ring at the other. The holding ring and the end of the box are fitted with felt washers to retain the oil.

Type C, or single end-thrust bearing, is for vertical or horizontal shafts supported by collars, which take the thrust in but one direction.





Radial Cage.

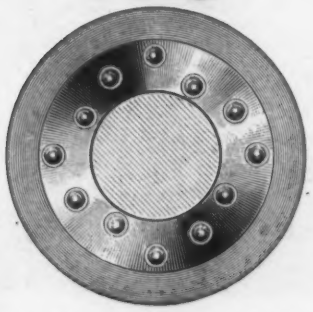
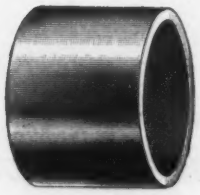


Fig. 2.—Single End Thrust Bearing.



"Sleeve."

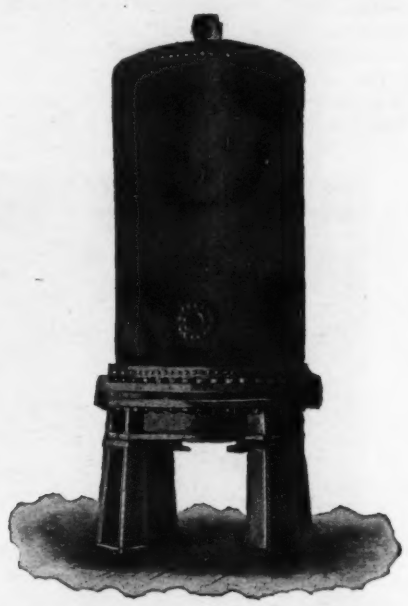
Among the classes of machine for which "Hub" ball bearings are recommended may be mentioned electrical machines of all classes, milling machines, loose pulleys, both horizontal and vertical, electric and other motors, fans, lathes, printing presses, etc.

Feed-Water Heater and Purifier.

The accompanying illustrations present two views of a feed-water heater and purifier furnished by the Kensington Engine Works, Ltd., Francis Brothers, Philadelphia, Pa., for the recently completed Philadelphia Bourse.

The heater is 60 inches in diameter, with shell 14 feet high over all, and has exhaust steam inlets and outlets 16 inches in diameter. It is provided with 350 square feet of heating surface, and heats the feed water used in the boiler supply to 206° by the exhaust steam from the electric-light engines and pumps, while also purifying it.

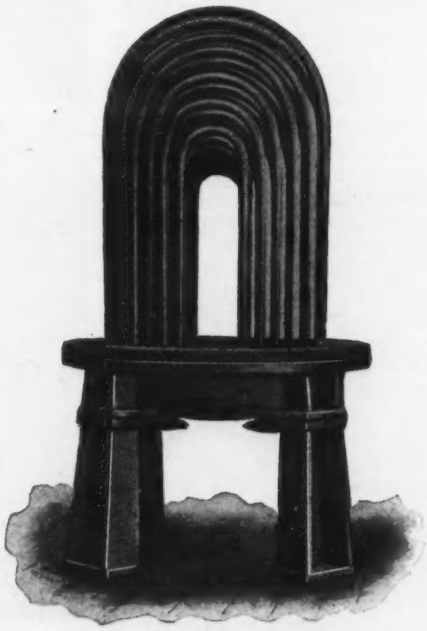
The heater is of the reservoir type, return tubular, and has a capacity of 1250 gallons. The exhaust enters at the bottom, and, passing through the tubes on one side, returns through the tubes on the opposite side,



Heater and Purifier Complete.

while the feed water is in the shell surrounding the tubes, thus absorbing rapidly the units of heat in the exhaust steam. There is a cast-iron base with projecting flanges on the top and suitable flanged nozzles on the bottom for the ingress and egress of the steam, and projections properly ribbed and braced are also provided for the reception and bolting to of the four cast-iron legs which support the heater at a suitable height from the floor.

Resting upon the top flange of the bottom casting is the tube head, made of semi-steel, similar to that used by the Cramps in guns, which is made convex in order the better to withstand and resist the pressure



Tubes of Heater and Purifier.

required to force the water into the boiler, which is 125 pounds per square inch.

The tubes, which are of seamless brass, and there forefree from corrosion and very durable, are securely expanded into this tube head, and

when so done the tubes and tube head become practically one piece or part of the apparatus.

The shell, which is of wrought steel, ½-inch thick, is designed to enclose the tubes and at the bottom end has a strong cast-iron ring securely riveted to it, with projecting flange corresponding in diameter to the flange of bottom casting and tube head.

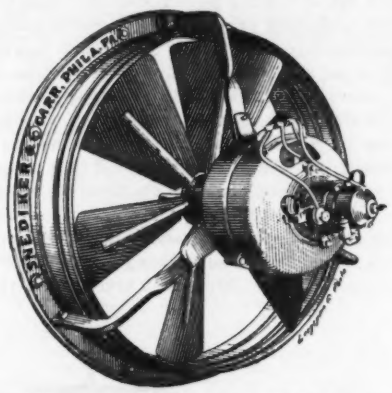
Feed water enters and leaves the heater by a 4½-inch pipe, and all impure deposit is blown out through a 3-inch mud blow at the bottom, while the impurities which float on the surface are removed through a 2½-inch surface blow. The connections provided are shown on the shell in Fig. 1.

A feed-water heater of the same diameter and general construction was installed by the Kensington Engine Works, Ltd., in the power plant of the Broad Street Station, Philadelphia, where it has given satisfactory results.

Electric Exhaust Ventilating Wheel.

Snediker & Carr, 139 and 141 North Seventh Street, Philadelphia, have just added to their line of ventilating machinery an exhaust wheel with an electric motor connected direct to its shaft.

The motor is of special type, almost entirely encased, and of the very best mechanical and electrical construction, and of high efficiency. It is placed in the centre of the wheel, where there is but little blade action.



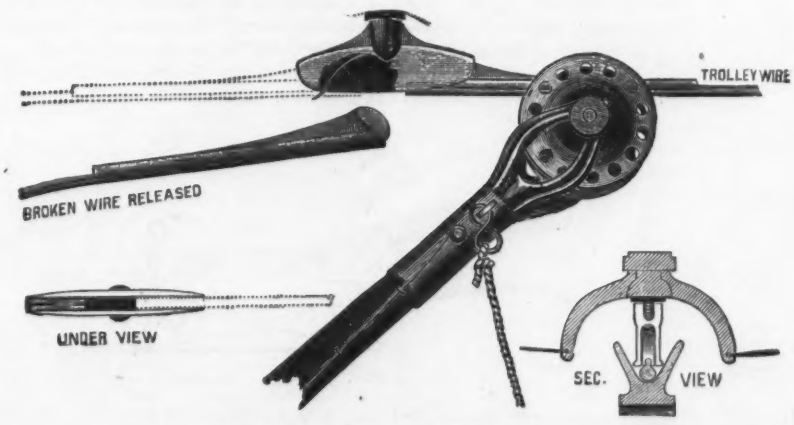
ELECTRIC VENTILATING WHEEL.

This exhaust wheel is adapted for the removal of steam, heat, gases, dust, smoke, etc., from boiler rooms, dynamo rooms, or mills of any description, and it can also be utilized for drying purposes.

Automatic Safety Hanger.

Mr. A. E. Hutchins, of Detroit, Mich., has patented a device intended to remove the element of danger in a broken trolley or electric light wire. It provides for the complete disconnection of a broken wire at the hangers at both ends of the section in which the break occurs, thus removing all possibility of danger. The broken wire does not dangle in the streets, but after releasing itself at the hangers drops bodily on to the road.

The device will be better understood by reference to the illustration. At the top is shown the automatic disengaging terminal-ears which engage and form contact with the oblique ledges and surfaces in the interior chamber of the safety hanger. It meets the requirements of providing large contact surface to its engaging surfaces, while the parts are protected from dust, sleet, etc., by the hood, as shown.



TROLLEY SAFETY DEVICE.

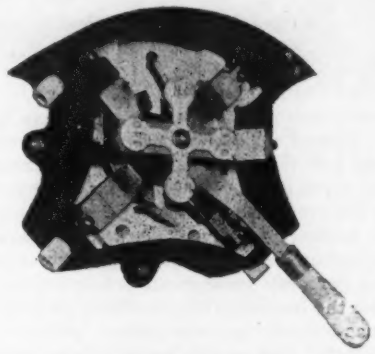
When a wire breaks, the hangers release immediately their hold on the ends of the section and thus remove all possibility of danger before the broken ends have time to reach the street.

This hanger was recently tested in Detroit with satisfactory results.

Improved Arc Cut-Out.

The accompanying illustration is of a new and improved arc cut-out that is being put upon the market by the Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa.

This cut-out is designed for heavy currents, and is guaranteed to carry



NEW CUT-OUT.

50 lights with safety. It has been produced with the object of meeting the demand for such a device, resulting from the increasing tendency toward the use of larger dynamos and higher voltages.

The Manhattan Enclosed Arc Lamp.

We illustrate herewith a form of enclosed arc lamp which combines several important features. The arc, being enclosed within partially air-tight opalescent globes, prevents the throwing out of sparks and carbon dust, while at the same time diffusion of light is obtained, thus removing all shadows beneath and above the lamp. These lamps may be operated at 80 volts, thus making a longer arc possible. The mechanism used is entirely without clockwork, carbon rods and dash pots, but simply consists of a solenoid with an armature and simple ring clutch. This lamp uses 18-inch upper carbon and 5-inch lower, and is but 37 inches long, while a second junior type is but 23 inches over all.

After burning for 150 hours there remains sufficient of the upper carbon to serve as a lower one, so that in a basis of 10 hours per day with carbons at $25 per 1000, the cost of carbons should not amount to more than 50 cents per lamp-year. This affords a great saving in this respect over the open-air lamp, at the same time reducing the labor expense.

MANHATTAN ARC LAMP.

These lamps, which are manufactured by the Manhattan Construction Company, of New York City, are now being sold by several of the largest illuminating companies. The Brooklyn Edison Company reports a saving in expense of $15 per lamp-year, while the Boston Edison Company reports

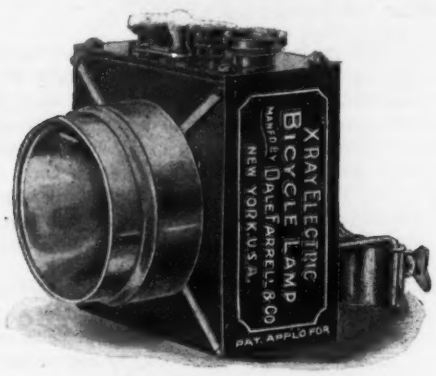
a saving of about $12 per lamp-year over the old forms. The watt-efficiency is practically the same as for the open-air lamp, the Manhattan lamp taking on a 110-volt circuit about five amperes, there being a drop of 28 to 30 volts in the series resistance. This is a loss of 150 watts, while the open-air lamp, having a drop of 15 volts in the series resistance, and taking 10 amperes, has the same watt loss.

Some New Specialties.

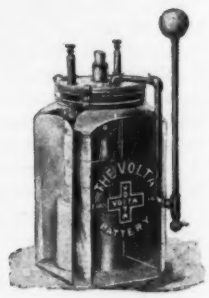
The accompanying illustrations show some of the specialties of Dale, Farrell & Co., of 150 Nassau Street, New York City.

The Volta primary battery shown in the cut has an E. M. F. of 2 volts, and one cell it is claimed will give a current of 25 amperes on short circuit. This battery does not polarize, and as it is hermetically sealed no noxious fumes are given off. It is easily charged, by filling the outside jar with water to the top of the zinc and the inside cell with "electroline." Dilute nitric acid answers very well also. It is claimed that the gas evolved from the carbon element creates a pressure in the centre cell and causes the acid to percolate through the porous cup and attack the zinc, and that the harder the battery is worked the more acid is forced through to the zinc. It has a capacity of 600 ampere-hours and the cost of recharging is very small. The zinc is large enough to last from 4 to 12 months, according to use. A special siphon is provided to draw off the spent liquid for the purpose of recharging.

The "X-ray electric bicycle lamp" gives a steady white light for six hours and is not affected by the vibration or jarring of the wheel. In fact, it is claimed that the light is improved thereby. There are no zincs to clean or renew, and no connections to make, as the zinc element is included in the cartridge with which the battery is charged. The charges are made in from one to six hour sizes, the largest charge being about the size of a cigarette, and can be placed in position in the battery without dismounting from the wheel.



Bicycle Lamp.



Volta Battery.

The magneto bells made by this firm are of first-class workmanship and finish, and are warranted to ring through the specified resistance. They do not infringe on any other patents, and embody valuable features which are protected by the company's own patents. The automatic armature cut-out of these bells throws the armature in and out of circuit as required. Instead of gearing, a chain and sprocket wheel are used, and the operation of the instrument is practically noiseless. The magneto testing bell contains the vibrating bells on the inside of the box, and a strap is provided for convenience in carrying the apparatus.

Magneto Bell.

The firm's factory, at 413 and 415 East Twenty-fifth Street, is fully equipped with all modern machinery for light and heavy work. The company makes a specialty of manufacturing bicycles and machinery for special work.

The company will have a large exhibit at the Electrical Exposition near the main entrance, and will be represented by Messrs. John C. Francis, George A. Lutz and Walter S. Doe.

The Lippincott Planimeter.

We illustrate herewith a new form of planimeter which obviates many of the annoying errors of types now in common use, and materially abridges calculation. A general view is shown in Fig. 1. A polar arm of constant length, *R C*, a tracing arm of variable length, *C T*, and a registering arm which carries a wheel. This arm is of glass in the form of a tube which is exhausted for partial vacuum, and in its interior is a paper scale which is thereby protected from discoloration and shrinkage from varying atmospheric conditions. The wheel has a sharp knife edge and therefore does not skid laterally, as do the wheels of all other planimeters or integrators, all lateral motion being performed by the sliding of the wheel upon the tube. Thus it will be seen that a finished surface, so essential to the operation of the ordinary planimeter, is not necessary with this instrument. It will be further noted that simple rotation of the wheel upon its axis does not register on the scale arm, therefore the diameter of the wheel is immaterial. In fact, its edges can be battered and bruised until it is almost unrecognizable and it will still indicate with absolute accuracy, the only difficulty being that due to the fact that the battered wheel runs less smoothly than a true wheel, the guiding of the tracing point is a little more difficult. The wheel and tube are shown in Fig. 2.

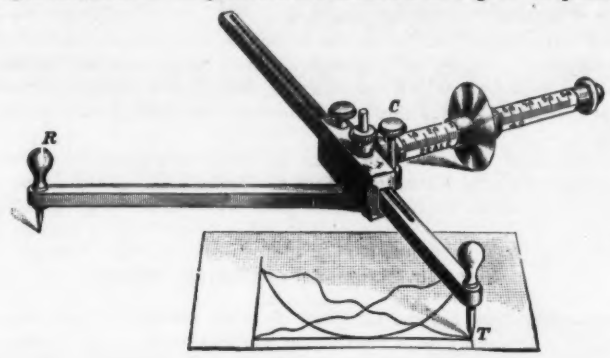


Fig. 1.

Fig. 2.

At *C* it will be noted that there is a little button which may be depressed and push a sharp point through the exact centre of the pivot of the tracing and polar-arm and thereby exactly locate it. Thus the tracing arm can be adjusted to any length with great accuracy. One or more tubes are supplied with a planimeter, each corresponding with two scales of indicator spring. By adjusting the tracing-arm to the exact length of the card, as shown in Fig. 4, clamping it in this position and selecting a tube of the proper scale, the indication thereon when the card is traced will be not the area, as is customary with other planimeters, but instead the mean effective pressure. The advantage of this is obvious to any one who understands the first principles of indicator cards.

Should the tube become broken, the makers of the planimeter, the Hine & Robinson Company, 57 Cortlandt Street, New York, will mail another tube on receipt of the paper scale unsoiled, and the necessary postage.

If it is desired to measure areas, instead of mean effective pressures, the *modus operandi* is very simple. It is merely necessary to set the length of the tracing-arm four inches, and select a tube with a 40 scale. The results will then be areas instead of mean effective pressures, and it will be seen that the length of the card and the scale of the spring cancel each other in the resulting sequence of figures.

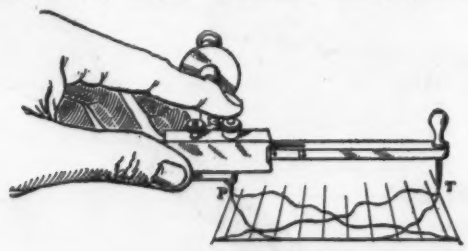


Fig. 3.

The instrument is put up in a fine morocco case and is neatly made. The principle of its design involves accuracy that is inherent, and this fact alone should commend it to all who have occasion to use it.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 2, 1896.

GENERAL ELECTRIC was very quiet, the trading being 9500 shares during the week. The highest quotation was 37⅝ and the lowest 36, closing at the latter figure, a net loss of 1¼.

WESTERN UNION was inactive, the quotation showing a net loss of one half for the week, and the number of shares changing hands being 5992.

WESTINGHOUSE remains unchanged.

A QUARTERLY DIVIDEND of 1 per cent. will be paid on May 18 by the Erie Telegraph & Telephone Company. On account of the dividend and annual meeting the stock books will be closed at noon on May 9 and opened on Wednesday, June 10. The net earnings of the company for the year amounted to $1604. The net gain in subscribers was 693.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97	99
" " " Brooklyn	100	100	102½
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	34¼	34¾
Electric Storage, pref	100	34½	35
General Electric	100	36¼	36⅛
General Electric, pref	100	..	75
Westinghouse Consolidated, com	50	29½	30
" " pref	50	53	54

BONDS.

Edison Electric Ill., New York	105	103	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	92

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	..	207
American District Telegraph	100	38	40
American Telegraph & Cable	100	94	97
Central & South American Telegraph	100	124	127
Commercial Cables	100	158½	..
Erie Telephone	100	60¾	61¼
New England Telephone	100	..	90
Postal Telegraph-Cable	100	87	87¼
Western Union Telegraph	100	85¾	86

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18½	18⅝
Brooklyn Rapid Transit		24	24¼
Brooklyn Traction	100	..	14
" " pref.	100	46	48
Buffalo St. Ry	100	73	75
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	47	50
Hestonville	100	49	49½
" pref		..	62½
New Orleans Traction	100	15	17
" " pref	100	61	65
North Shore Traction	100	30	31
" " pref	100	80	83
Rochester St. Ry	..	25	30
Steinway, Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14⅛	14¾
West End, Boston	100	70¾	71½
" " pref	100	90	..
Worcester Traction	100	16½	18
" " pref	100	87½	89½

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78	80
Buffalo St. Ry. 1st con. 5s	100	106	..
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—Brooklyn City Railway stock was the only strong or active security in the traction list. There was a good volume of trading during the week and an advance of about three points.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 4, 1896.

ROSSITER, MacGOVERN & CO. have moved their offices from 141 to 107 Liberty Street.

MR. McCHESNEY, of Huebel & Manger, Brooklyn, will represent this firm at the Exposition. Messrs. Huebel and Manger will also spend much of the time at their exhibit.

MR. R. O. HEINRICH is about to sail for Europe for an indefinite period, and owing to his hasty departure wishes to bid farewell to his many friends through the medium of this column.

CHARLES J. BOGUE, 206 Centre Street, will attend the electrical convention. He has built up a great reputation as a repairer of dynamos, commutators, etc., and is kept constantly busy.

IN MEMORIAM.—We have received a copy of the memorial of Franklin Leonard Pope, reprinted from the transactions of the American Institute of Electrical Engineers. It contains an excellent half-tone illustration of the deceased, and another showing his home in Great Barrington, Mass.

INDEX TO LABORATORY REPORTS, 1 TO 400.—The Electrical Bureau of the National Board of Fire Underwriters, 156 Broadway, New York, and 157 La Salle Street, Chicago, have just issued a list of tests of devices brought before them for consideration. Full accounts of any tests, with the results obtained, will be forwarded on application.

C. C. SIBLEY & CO., selling agents for the General Electric Company, for New York City, moved their offices, on May 1, from the Postal Telegraph Building to their new store at 329 Fourth Avenue, between Twenty-fourth and Twenty-fifth Streets. They will carry a full line of contractors' supplies, including interior conduit, bell and annunciator supplies.

THE DALE MANUFACTURING COMPANY, manufacturer of electric lighting specialties and electric fixtures, has removed from 22 Cortlandt Street to the Dale Building, 108 Greenwich Street. The company occupies at its new location a floor space of 5000 square feet. It has done a successful business during the past year. Mr. L. J. Riley, formerly with the old A. B. C. Company, is one of the partners.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York City, will have in its exhibition a line of Bergmann arc lamps for direct and alternating currents, including samples of ornamental enclosed arcs, having a life of 150 hours; a complete line of the Sun-Smeltzer-Nuernberg carbons for direct and alternating-current lamps, and Bergmann switches of latest designs for various uses. Mr. R. B. Corey, the general sales agent for the company, will be in charge of its exhibit.

SUBWAY EXPLOSION.—On April 30 an explosion occurred in the main subway of the New York & New Jersey Telephone Company, which runs through Fulton Street, Brooklyn. Four man-holes at different points were blown out by the explosion of escaping gas. The shocks tore up the surrounding pavement and broke several windows in the immediate vicinity. While there were some narrow escapes among pedestrians no one was injured, and the subways themselves suffered slight damage.

MAGNETIC CLUB.—The Spring meeting of the Magnetic Club was held at "The Tuxedo," Madison Avenue and Fifty-ninth Street, on the night of April 29. An excellent menu was provided, and there was a large and enthusiastic attendance. Addresses and instrumental and vocal music constituted the after-dinner exercises. Among those present were Frank J. Sprague, William Marshall, H. L. Shippy, A. P. Eckert and J. J. Carty. Letters were read from several Boston members, who stated that the dinner and the Electrical Exposition and convention coming so closely together rendered it impossible for them to be at both, and regretted being compelled to miss a good dinner.

T. J. MURPHY & CO., 136 Liberty Street, manufacturers of panelboards and switchboards, have removed their factory to 511 West Thirteenth Street, where they will have greater facilities for handling their expanding business. This firm is now making special switches for switchboard work, and a set of these will be shown at the Electrical Exposition on Augustus Noll's board. The Weston Instrument Company, of Newark, N. J., and the Interior Conduit & Insulation Company, of New York, will also have as part of their exhibits boards constructed by T. J. Murphy & Co. These three boards will exemplify the use of marbleized slate, polished black slate and Tennessee marble for switchboard work, also a new method of erecting boards, on brass or iron pillars, doing away with the iron-supporting frames formerly used. Other manufactures of switchboard construction will be shown.

THE PHŒNIX INTERIOR TELEPHONE COMPANY, manufacturer of telephones and electrical supplies, has removed its factory to the Dale Building, 108 Greenwich Street, where it will have more room and better facilities to supply its customers more promptly, and to meet the increasing demand for its electrical specialties. This business was organized in 1894 at

131 Liberty Street, and has steadily increased under the management of Messrs. John H. Scofield and G. W. Tutton, who are deservedly popular and possessed with up-to-date business tact. This company has also opened a salesroom and business offices at 123 Liberty Street and 157 Greenwich Street. This office is fitted up in good shape. The large show window on Greenwich Street is artistically decorated with numerous electrical specialties manufactured by the company. This company is making a big drive on its granular transmitters. It will shortly carry a full line of electrical supplies.

STRIKE OF ELECTRIC ELEVATOR EMPLOYEES.—The electric elevator constructors employed by the Sprague Electric Elevator Company in the new Syndicate Building, at Liberty and Nassau Streets, struck recently for the alleged reason that the Sprague Company refused to grant an eight-hour day, adopt the union schedule of wages, and grant other demands. Mr. F. J. Sprague states that these statements are unqualified falsehoods, and charges the Elevator Constructors' Union with misrepresentation of the true facts. The Sprague Company granted the increase of pay asked for, but for good reasons could not accede to the demands of the union to limit the helpers on any one job, and that all employees shall be members of the Elevator Constructors' and Millwrights' Union No. 1. Owing to the special nature of the Sprague Electric Elevator Company's business, which necessitated the employment of a specially trained force of men, it would be impracticable, unwise and dangerous to carry out these demands. At this writing the trouble remains unsettled.

THE STEAM BOILER PLANT.—The improved Root water-tube boiler, manufactured by the Abendroth & Root Manufacturing Company, of New York, will furnish all the steam used at the Electrical Exposition, there being two equal units forming one battery of 500 horse-power of boilers, and the anthracite automatic stoker, manufactured by the Wilkinson Manufacturing Company, of Bridgeport (Montgomery County), Pa., will handle the coal supplied to the fire. The coal, after being dumped at some distance from the boilers, in the rear, is taken by the C. W. Hunt coal conveyor, and carried along the side and a little past the front of the boilers, where it is elevated to a point near the ceiling from whence it is delivered through tubes to the hoppers of the Wilkinson stokers, and, of course, from that point it is fed uniformly down the inclined grates, burning on its way and reaching the foot of the grates as ash, and finally it is dumped into the ash pit below. The Hunt conveyor next takes the ash and carries it back to a dumping place some distance in the rear of the boiler, dumping it there automatically. The pump supplying feed water to the boilers is one of the H. R. Worthington Company's make. It will be electrically driven by one of Crocker-Wheeler Company's pump motors. The pump is one of the "steeple pattern" and combined with its motor presents a novel and elegant appearance. Two of the Root feed-water regulating devices, manufactured by the Abendroth & Root Manufacturing Company, of New York, will work in connection with the boilers and feed pump, starting the pump automatically when the water level in the boiler falls below its proper level and again stopping the pump when the water in the boiler tends to rise above its normal working level, and the damper regulator of the Locke Damper Regulator Company, Salem, Mass., completes the entire automatic equipment. The valves used in the main steam piping are especially adapted to high pressure and ordinary rough handling, and are made by the Chapman Valve Manufacturing Company, of Indian Orchard, Mass. The pressure carried by the boilers will be 125 pounds. This pressure will be carried along the main steam piping to a point just beyond the first engine, and there it will be reduced by a Foster reducing valve to 90 pounds, at which pressure it will be carried to all of the other engines on exhibition. The boilers are equipped with steam gauges manufactured by the Ashcroft Manufacturing Company, and with nickel-seated pop safety-valves made by the Consolidated Valve Company, both of New York and Bridgeport, Conn. The fine, smooth, black finish of the boiler work is produced by the use of Dixon's graphite boiler front paint made by the Joseph Dixon Crucible Company, of Jersey City, N. J. The engines on exhibition will all be direct-connected with generators with two exceptions, which will be connected by belting. The engines will be found arranged in the following order, beginning with the engine nearest to the boilers: The Phœnix engine (the only compound engine), the Ball & Wood engine, the Straight Line engine, the Harrisburg engine, the Watertown engine, the Payne engine, the McEwen engine, the Weston engine (belted), the New York Safety Engine Company (belted), the Case engine, the Shepard engine, the Woodbury engine. The exhaust from all of these engines will be passed through a Goubert feed-water heater, and then sent through the spiral riveted exhaust pipe, placed outside of the building, to a point above the roof. Two concerns share the steam-pipe covering work, one putting on Keasby's magnesia sectional covering, while the other applies Gilmour's asbestos covering.

Niagara Falls Notes.

Niagara Falls, N. Y., April 30, 1896.

THE LATEST ATTEMPT at long-distance telephoning is to be undertaken by the Bell Telephone Company, of Buffalo, in transmitting the roar of the great cataract of Niagara to New York. This is to be done next week in the interest of the Electrical Exposition. General Superintendent J. N. Culbertson, of the Bell Company, arrived here Wednesday and, accompanied by the company's electrician, went to Prospect Point and made a survey of the location to see where the transmitter can be placed. It was decided to erect a six-foot long funnel, with the open end projecting over and downward from the brink of the falls, so as to catch the deep and mighty roar as it arises from the depths. The funnel will be riveted to the transmitter. This will be connected by underground wires with the long-distance metallic line of the Bell Company, and each evening when the line is not busy, the roar of the falls of the Niagara will be heard in New York. Mr. Culbertson is confident that he will be successful in this effort, and certainly it will be a novelty worth going to hear, if Niagara's roar can be transmitted to New York, fully 500 miles distant.

IT IS NOW DEFINITELY KNOWN that a current of electricity will be transmitted from the big stone power-house of the Niagara Falls Power Company to the Electrical Exposition in New York City, to run the model of the power development to be placed on exhibition there. Local Manager Little, of the Postal Telegraph Company, has received word from the New York office to connect the line with the power-house with three wires. He will immediately do so. It is the design of the Power Company to use the three-phase current, consisting of two transmission wires and one ground wire. Only a fraction of an ampere will be used, and as to the question of making a test of long transmission, that is absurd. It is designed to use the wires at night when not busy. To run the model during the day the Power Company has charged some 22 cells for a storage battery, which will be sufficient to run the model all through the Exposition. It can thus be said that the model was run by electricity generated by the power of Niagara Falls. Superintendent Lincoln, of the Niagara Falls Power Company, said that the amount of electricity to be transmitted is so small that it can hardly be computed, and it is designed to use it only an hour or two each evening. The Power Company will contribute to the exposition a *fac-simile* of the seal of the incorporated company; a model of the turbine which runs the 5000-hp generators; a model of the power-house and tunnel. Some 22 first-class modern storage batteries will be charged with electricity at the power-house and sent down to run the model during the day time.

Philadelphia Note.

Branch Office of The Electrical World,
927 Chestnut Street,
Philadelphia, Pa., May 1, 1896.

MR. JAMES McLAUGHLIN, recently with the Philadelphia Engineering Works, Limited, has been elected secretary and treasurer of the Barr Pumping Engine Company, Philadelphia. Mr. W. W. Lindsay is the general manager of the latter company,

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., May 1, 1896.

CAMBRIDGE will not establish and maintain its own electric light plant. This decision was reached by a special election this week, in which, however, very little interest was manifested, a very light vote being cast.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY has been appointed New England agent for the Siemens & Halske Electric Company of America, and has opened a new office in the John Hancock Building, Boston. Mr. H. C. Spaulding is manager of the new office.

THE SPRINGFIELD ELEVATOR & PUMP COMPANY has been organized in Springfield, Mass., with a capital of $100,000. The company will manufacture a complete line of electric, hydraulic and power elevators for all classes of service, besides all the steam and power pumps of the Valley Pump Company, to which will be added electric power pumps and a complete line of electric power motors. Among the Board of Directors is Mr. Fred. B. Corey, M.E., a well-known electrical expert, of Boston, who becomes secretary of the new concern. Mr. Corey is now fitting up an office and show-room at 47 Pearl Street, Boston, where he will carry a line of pumps and other machinery.

THE BALL-BEARING COMPANY, Boston, has already made in the electrical field a creditable record for its "Hub" anti-friction ball-bearings for general machine construction. Wherever these bearings have been applied they have given entire satisfaction, after most exhaustive tests demonstrative of their saving power, desirability and economy in power transmission. Mr. Henry M. Whitney, whose name alone will favorably attract the electrical fraternity, is president of the company. Mr. W. S. McGowan, Jr., is the capable, courteous and energetic secretary. The exhibit of these ball-bearings at the Convention-Exposition in New York is sure to attract attention, and to those who may not attend the Exposition the neat catalogue just issued illustrating and explaining them will be forwarded upon request to the Boston office.

THE PETTINGELL-ANDREWS COMPANY, Boston, has just issued a handsome illustrated catalogue of 188 pages and cover—third edition—the sole work of its general manager, Mr. Chas. B. Price, and upon whom it reflects exceeding credit. Every electrical device or specialty is nicely presented with prices, and the catalogue will undoubtedly be generally treasured and appreciated, as it is an "invaluable reference for electrical supplies from a leading successful and aggressive electrical supply establishment." This concern will not have an exhibit at the Convention-Exposition, as each of the leading manufacturers which it represents will have extensive displays. Over these exhibits are conspicuous signs stating that the Pettingell-Andrews Company is their sole New England agent. The above signs appear over the following exhibits. The Interior Conduit & Insulation Company; the Okonite Company, the Standard Paint Company, and the Bryant Electric Company.

EXTENSIVE ELECTRIC RAILWAY SYSTEMS.—Robert H. Derrah, secretary to President Little, of the West End Street Railway Company, has prepared an interesting map showing the extent of street railways in Massachusetts. Very few people understand that a continuous journey can be made from Gloucester, Mass., or Nashua, N. H., on street railway lines, not only to Boston, but through Boston to Brockton, and with the completion of lines proposed through Bridgewater to Taunton, to Fall River and Fairhaven, upon the south shore of Massachusetts. The trolley lines also extend southwest to Milford, only a few miles from the eastern terminus of the Worcester Street Railway, now ending in Grafton, and with this gap filled a continuous trip can be made from Boston to Spencer. Development on account of the electric road has been pretty extensive around Braintree and Brockton upon the South and Woburn, Wakefield and Beverly on the North. The valley of the Connecticut River has also developed a considerable trolley system of its own.

THE PROVIDENCE STEAM ENGINE COMPANY, Providence, R. I., builders of the improved Greene engine, reports a large amount of orders on hand and its shops full of work. Among the recent shipments and engines

now being installed are the following: One 500-hp, Baltimore Sugar Refining Company, Curtis Bay, Md.; two 700-hp engines, Mount Vernon Construction Company, Washington, D. C.; one 150-hp, Iroquis Rubber Company, Setauket, N. Y.; one 350-hp tandem compound, Arnold Print Works, North Adams, Mass. one 600-hp cross compound, Georgia Electric Light Company, Atlanta, Ga.; one tandem compound, 300-hp, Pencoyd Iron Works, Pencoyd, Philadelphia, Pa.; one 100-hp, Peninsular Electric Light & Power Company, Newport News, Va.; one 75-hp, Rochester Car Wheel Works, Rochester, N. Y.; one 350-hp tandem compound, Griffin Manufacturing Company, Griffin, Ga.; one 1000-hp, Cocheco Manufacturing Company, Dover, N. H.; one 500-hp, Richmond Locomotive & Machine Company, Richmond, Va.; one 350-hp, Kensington Electric Company, Philadelphia, Pa.

WASHINGTON NOTE.

WASHINGTON, D. C., April 30, 1896.

THE SUB-COMMITTEE on the House District Committee have reported a bill providing for the construction of a general system of municipal subways, to be under the control of the district. The sum of $200,000 is appropriated to begin the work. The estimated cost, embracing 62 miles, is $539,000. All of the revenues derived from the rentals will belong to the district. The commissioners shall rent the conduits to all telephone and electric light companies desiring to use them. All overhead wires shall be placed in the conduits within 30 days after the passage of the bill.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., April 30, 1896.

THE BALL ENGINE COMPANY, Erie, Pa, has removed its Chicago office to the Monadnock Building, Room 1526.

THE AMERICAN REFLECTOR COMPANY, of Chicago, is at present engaged in the design of 109 special lighting reflectors to be used in the store of C. D. Peacock.

THE CENTRAL ELECTRIC COMPANY, of Chicago, have just issued a pamphlet on the Lundell fan motors for direct and alternating currents, which they are now ready to send on application.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, informs us that it is continually increasing its facilities for the manufacture of the Sunbeam Röntgen ray tubes and is still behind on orders received.

MR. JAMES WOLFF, Western representative of the New York Insulated Wire Company, left for New York on Saturday to attend the Convention. As a worker Mr. Wolff has no equal, and is one of the most popular gentlemen in the business

MR. E. F. COLDREN, one of the proprietors of the Buckeye Electric Repair Works, Columbus, O., is in Butte City, Mont., winding a number of armatures for the Butte Consolidated Railway Company. Mr Coldren is an old employee of this company.

IDEAL HIGH ART ENGINES are very handsomely illustrated and described in a new catalogue just issued by A. L. Ide & Son, Springfield, Ill. builders of the well-known Ideal engines. These machines enjoy a first-class reputation in the electrical trades.

THE CLARENCE E. VAN AUKEN COMPANY, Chicago, has just issued a newly illustrated catalogue, setting forth the qualities of its damper regulator, steam trap, pump governor, pressure regulator, separator and other devices. This catalogue will be mailed by the company free upon application.

THE LAFAYETTE ENGINEERING & ELECTRIC WORKS, Lafayette, Ind., has just issued a very artistic catalogue of its dynamos, motors, arc lamps and electrical specialties. The catalogue is well illustrated, and at the back contains a valuable table of horse-power required for various machines. The transmission of power also receives consideration in its pages.

THE ARMORITE INTERIOR CONDUIT COMPANY, Detroit, Mich., informs us that it is manufacturing a complete interior conduit system, known as "Armorite." The tubes are lined with wood cut in semi-cylindrical sections, and forced into the armor. Ordinary bends can be made cold by the workman on sizes up to one inch. A complete price list has recently been issued by the company.

THE METROPOLITAN ELECTRIC COMPANY has just taken the agency for the Diehl Manufacturing Company, of Elizabethport, N. J, and will carry in stock a complete line of ceiling fan motors. The Diehl Manufacturing Company is one of the oldest manufacturers in the country of ceiling fan motors in their various shapes and styles, and the Metropolitan Electric Company is therefore starting on a good basis for a successful season.

MR. JOHN GORMAN, for 20 years practical electrician and dealer in electrical apparatus in St. Paul, Minn, will represent the Metropolitan Electric Company in handling N. I. R. wire, Metropolitan lamps, "Mac" tape, P. & B. compound varnish, etc. Mr. Gorman is prominently identified in electrical interests in St. Paul and Minneapolis, and has done a large share of the electrical work in that section during the last 20 years. The Metropolitan Electric Company can be congratulated in getting Mr. Gorman to handle their goods.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., has just published a leaflet relative to its new course, known as the "Electrical Workers' Course." This course covers the principles of the various electrical mechanisms, wiring plans, descriptions and illustrations of electrical supplies, and instructions in the use and installation of same; rules of safety and of good electrical engineering construction; specifications and estimates of cost of both labor and material; testing for grounds, short circuits and other electrical faults, and many valuable hints and practical suggestions.

MR. W. H. SILLS, formerly Western sales agent for Eugene Munsell & Co., mica dealers of New York, has severed his connection with that company, and will hereafter engage in business for himself with offices at 59 Lake Street, Chicago. The business will be conducted under the name of W. H. Sills & Co., and will carry one of the most complete stocks of mica in the West. During Mr. Sills' long connection with the mica interests in Chicago, he has built up an excellent reputation among the electrical fraternity, and it is to be hoped that his new venture will meet with the success which his energetic efforts merit.

LARGE CONTRACTS.—The Walker Manufacturing Company, Cleveland, O., during the past week closed a contract with the Chicago City Railway Company for six 800-kw rope-driven generators to run at a speed of 220 revolutions per minute. These are the largest belt-driven machines in the world. Two of these machines will be driven from one engine of the cross-compound type, the engines having a capacity of 2500 horse-power. The Walker Company has also received, during the past 10 days, an order for the first large storage-battery road in the world. The Chicago & Englewood Railway Company will operate about 50 storage-battery cars, the motors, controllers, etc., being of the Walker make. The storage batteries will be charged from a central station, containing four large direct-coupled Walker generators. This road will be one of the most interesting ever built, the Electric Storage Battery Company of Philadelphia furnishing the batteries. The Arnold system of generator drive will be used. Everything about this plant and equipment will be the best that has ever been brought out by any manufacturer. All the machinery and apparatus will be highly finished, and it is expected that an excellent record will be made in the cost of operation with this plant. The road will have about 50 miles of track constructed in the best possible manner. The Metropolitan Street Railway Company, of Kansas City, also placed an order for a large Walker generator, 1200-kw capacity, direct-coupled to an Allis tandem-compound engine for its station in Kansas City. Besides the above, the Walker Company has received orders during the past month for a large number of motors and complete car equipments from the following named companies: Rapid Railway Company, Detroit, Mich.; Pittsburg, Grafton & Mansfield Street Railway Company; Second Avenue Traction Company, Pittsburg, Pa; Newburgh Electric Railway Company, Newburgh, N. Y.; Union Railway Company, New York City; C. E. Loss & Co., Chicago, Ill.

THE ELECTRICAL INDUSTRIES move apace, and scarcely a year passes which does not witness the addition of a new art or a new vocation to the many clustering around the subtle current. The present year witnesses the advent of the electrical lawyer. For some time past the mass of litigation growing out of the electrical patents has called forth patent lawyers equipped to handle the intricacies of the electrical arts, but until the present, civil and commercial cases, that is, causes other than patent causes, have been entirely handled by boy lawyers, possessing little or no knowledge of electrical subjects. The rapid growth of the electric lighting and the electrical railway industries has given rise to a large number of legal questions, requiring in the lawyer, for their proper presentation to the court, a thorough knowledge of electrical subjects. Of such nature are the questions arising from the interference of electric railway currents with the telephone currents, and the destruction of the pipes of water-works and gas companies, by the ground currents of electric railways. A large number of technical questions likewise grow out of contract relations in the installation of electrical apparatus, where it is claimed that the apparatus does not meet the requirements of the specifications, thus necessitating an inquiry into highly technical matters. Further questions arise in the nature of damage cases, where a person or property is damaged by the faulty construction or operation of apparatus, boiler explosions, shocks from live wires, fires attributed to electrical causes and the like. The field of the electrical lawyer is that of counsel to electrical corporations in all questions that may arise in connection with their business, and advisory counsel to the legal profession where highly technical questions are involved. The first lawyer to enter this new field is W. Clyde Jones, who has established an office at 1107 Title & Trust Building, Chicago. Mr. Jones has had wide experience in the electrical industries. He is a graduate of a course in electrical engineering at the Iowa State College, and after practical experience in the design and installation of apparatus, took a law course at the Chicago College of Law. For the last four years he has been associated with the well-known firm of electrical patent lawyers, Barton & Brown, and has acted as an electrical expert in a number of litigated matters, and is at present the president of the Chicago Electrical Association, thus bringing to his new field a thorough knowledge of electrical matters which admirably fits him to weld together in a new profession the two most highly respected professions, the oldest and the youngest, law and electricity.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, April 22, 1896.

HOUSE WIRING.—The Council of the Society of Arts are offering a "Fothergill prize" of £25 and a silver medal for a paper on "The Best Means of Effectually Preventing the Leakage of Current to Earth in Electrical Installations, From Generating Heat and Setting Buildings on Fire." This paper is to consist of about 8000 words, and is to be sent in on or before the 1st of October next.

LONDON TRAMWAYS.—The *Pall Mall Gazette*, an evening paper distinguished for its sensational tone, has lately been endeavoring to startle the public with vague statements with regard to an immense tramway trust, which, so it says, is about to be formed. According to this authority the idea is that all the different tramway concerns of London should be amalgamated, and that a long lease should be obtained from the County Council on the basis of handing over to that body a sum equivalent to the present profits of the tramway companies of London.

MUNICIPAL TELEPHONY.—Notwithstanding the fact that at the time Government induced Parliament to vote a million sterling for the purpose of enabling the post-office to purchase the trunk wires of the National Telephone Company and extend them, it was specifically laid down that licenses would be granted to municipalities wherever good cause could be shown, the present Government, like its immediate predecessor, persists in throwing cold water on the idea of municipal telephony. Some hope, however, has been held out to municipalities, for, if they like to purchase the local telephone undertaking, they will have the assistance of the post-office in securing fair terms from the

National Telephone Company. This plan, although from the £ s. d. point of view, would probably be no more expensive than the starting of a competitive telephone line, is not likely to commend itself in an equal degree to the progressive minds among our leading municipalities.

General News.

New Incorporations.

THE FRANKLIN LIGHT & POWER COMPANY, Franklin, N. H., has been formed by Frank L. Morrison, E. H. Sturtevant and Michael Duffy, Franklin Falls, N. H. Capital stock, $100,000.

THE CENTRAL KENTUCKY TELEPHONE COMPANY has been organized at Harrodsburg, Ky. The incorporators are C. D. Thompson, James T. Wilson, E. M. Wiley, E. H. Gaither and J. A. Kelly.

THE NEW ENGLAND ELECTRICAL TRADES ASSOCIATION has been organized at Boston by Frank Ridlon, Walter S. Barker and David A. Andrews, Jr., to exchange information and regulate matters of interest. Capital stock, $250.

THE CITIZENS' TRACTION COMPANY, San Diego, Cal., has been organized by C. B. Kerber, Cincinnati, O.: C. W. Foote, C. C. Arnold, J. E. O'Brien, and J. B. Mannix, San Diego, to build a street railway in San Diego. Capital stock, $100,000.

THE SACRAMENTO ELECTRIC, GAS & RAILWAY COMPANY, Sacramento, Cal., with a capital stock of $2,500,000, has been organized by J. W. Hall, L. T. Hatfield, Sacramento, and Albert Gallatin, Jr., San Francisco, for the purpose of supplying electricity for light, power, etc.

THE STEVENS ELECTRIC COMPANY has been incorporated at Fort Fairfield, Me., for the purpose of selling and distributing electricity for light, heat and manufacturing purposes. The incorporators are L. W. Stevens, J. S. Stevens, A. E. Stevens and H. D. Stevens, Fort Fairfield, Me.

THE McCASKEY & HOLCOMB COMPANY has been organized in Springfield, Ill., for the purpose of generating and distributing electric current for light, heat, power and manufacturing purposes. The capital stock is $25,000 and the incorporators are W. T. McCaskey, Eugene Holcomb, and M. S. McCaskey.

THE DE WITT LIGHT & POWER COMPANY has been incorporated at De Witt, Ia., with a capital stock of $6000, for the purpose of building and operating electric, gas and steam heating plants. The incorporators are W. A. Cotton, A. M. Price, W. H. Talbot, J. B. Webb, T. F. Reed and J. A. Hannum.

THE DAYTON ELECTRIC LIGHT COMPANY, Dayton, Tenn., has recently been reorganized by Thomas Webb, of Logan, O.; J. H. Crawford, of Nelsonville, O., and S. Nelson, of Dayton, Tenn. A new 100-hp boiler will be put in, and the plant will be in operation by the 1st of June, with 27 arc lights and 250 incandescents.

THE TUOLUMNE COUNTY ELECTRIC POWER & LIGHT COMPANY, San Francisco, Cal., has been organized with a capital stock of $1,000,000. The incorporators are W. D. Bannister, Columbia; James McCormick, Sonora; John J. Crooks, P. R. Jarboe, San Francisco; William Grant, David Hearfield and A. F. Fechteler.

THE COMMONWEALTH MANUFACTURING COMPANY, Kittery, Me., has been incorporated with a capital stock of $200,000 for the purpose of manufacturing and dealing in patented incandescent electric light manipulators. The incorporators are John W. Regan, Jr., Joseph J. Dunn and Gilbert H. Smith, of Boston, Mass.

THE PASSAIC ELECTRIC MANUFACTURING COMPANY has been incorporated at Paterson, N. J., with a capital stock of $5000, for the purpose of manufacturing and selling electrical switches and equipping electric plants. The incorporators are Jay Holmes, John E. Beggs and Frederick Beggs, all of Paterson, N. J.

THE PAMLICO & BEAUFORT TELEPHONE COMPANY has been organized in Aurora, N. C. The lines of the company will be over 50 miles in length and it is proposed eventually to extend them to New Berne. The incorporators of the company are J. F. Cowell, Bayboro, president, and J. W. Chapin of Aurora, secretary and treasurer.

THE KAHOKA TELEPHONE & CONSTRUCTION COMPANY, of Kahoka, Mo., has applied for articles of incorporation. The capital stock will be $3000, and the incorporators are J. R. Hume, Horace Longanecker, S. S. Davis, Loyd Stauffer and Thomas Doran, of Kahoka; J. W. Fonda, of Luray, and W. W. Weber, of Wyaconda.

THE UNION RAILWAY COMPANY, Denver, Col., has been organized by Benjamin A. Jackson, Providence, R. I., William W. Field, Harlan P. Parmelee, Herman H. Dunhan and George C. Preston, Denver, Col., for the purpose of building a system of street railways to be operated by electricity, gas or cable. Capital stock, $1,000,000.

THE W. D. GRAVES ELECTRICAL & MACHINE COMPANY has been formed at Cleveland, O., for the purpose of manufacturing and dealing in electrical supplies and machinery and also for the construction of electrical plants. The capital stock is $15,000, and the incorporators are B. M. Barr, W. T. O'Mara, F. P. Stone, W. D. Graves and J. C. Perene.

THE NORTHERN NEW JERSEY CONSTRUCTION COMPANY has been organized at Hackensack, N. J., with a capital stock of $100,000, for the purpose of building, constructing or repairing railways, water, gas or electric works. The incorporators are Frank O. Mittag, Park Ridge, N. J.; John Eckerson, Westwood, N. J., and Frederick C. Miller, Woodcliff, N. J.

THE MARTINSBURG ELECTRIC COMPANY has been incorporated in Martinsburg, Va., with a capital stock of $700 minimum and $50,000 maximum. The incorporators are: L. C. Cerling, F. E. Wilson, Geo. W. Trimble, A. J. Thomas, Wm. E. Teho and H. J. Seibert, all of Martinsburg. The company will manufacture and supply electricity for light, heat and power.

THE TROUT FALLS LAND & IMPROVEMENT COMPANY, Denver, Col., has been formed for the purpose of laying out town sites in Douglas County, improving the same, building electric light plants and water works. The incorporators are C. J. Woll, F. P. Woolstone, Ralph E. Pierce, A. J. Condon and W. S. Ferguson, Denver, Col. Capital stock, $200,000.

THE FARQUHARSON ELECTRIC GAS LIGHTING COMPANY, of New York, N. Y., has been incorporated in West Virginia for the purpose of manufacturing electrical inventions and appliances for gas lighting The incorporators are Henry C. Farquharson, D. Frank Root, Roy W. Randall, New York City. Capital stock, minimum, $100; maximum, $100,000.

THE STATE BELT TELEPHONE & TELEGRAPH COMPANY has been organized in Pittsburg, Pa., with a capital stock of $10,000. The directors are C Miller, John A. Miller, Joseph I. Heinzleman, Nazareth; John E. Stofflet, Mutchler; Charles J. Koch, Pen Argyle; Charles N. Miller and Thomas Ditchet, Bangor; William Bray, East Bangor, and John I. Miller, of Portland, Pa.

THE GOFF ARC LAMP MANUFACTURING COMPANY has been organized at Camden, N. J., for the purpose of manufacturing, buying and selling various kinds of electrical machines, works and appliances and doing a general electrical manufacturing business. The capital stock is $30,000 and the incorporators are Samuel B. Goff, Richard T. Eschler and Charles Richter, Camden, N. J.

THE GOVANSTOWN WATER & ELECTRIC LIGHT COMPANY has been incorporated at Govanstown, Md., by Lawrence B. McCabe, Augustus D. Clemens, Jr., Henry M. Walker, Leander Foreman, William S. Norris, Bartholomew Balls, Barnabas Balls, Frederick E. Wilson, Dr. Edward M. Duncan, Louis G. Onion, John L. Rosensteel and Hugh J. Gallagher. The capital stock is $50,000.

THE MERCER TELEPHONE & TELEGRAPH COMPANY, of Mercer, Pa., has been incorporated to maintain a system of telephone and telegraph lines in the counties of Lawrence, Butler, Venango and Crawford. The capital stock is $20,000, and the directors are George W. Wright, B. Magoffin, L. R. Heath, H. H. Ziedler, Mercer; T. E. Crossen, Greenville; J. M. McCutcheon, Grove City, and F. K. Keiser, Sharon.

THE UTICA SUBURBAN RAILWAY COMPANY, Utica, N. Y., has been organized with a capital stock of $50,000. It is proposed to construct and operate an electric street surface road. The directors are Camille Weidenfeld, Oyster Bay, L. I.; James T. Gardner, Albany; W. B. Puntney and E. Peckham, of New York City; Charles E. Smith, John S. Capron, John W. Boyle, of Whitesboro; William Kernan, P. H. Yale, D. J. Vedder, J. S. Davies, T. S. Jones, B. G. Young and J. H. Grant, of Utica.

Electric Light and Power.

GLEN RIDGE, N. J.—The Borough Council favors the introduction of electric lights in this place.

DES MOINES, IA.—It is likely that the three electric light plants in this city will be consolidated.

ST. PAUL, MINN.—The St. Paul Gas Light Company will expend $50,000 in improving its plant and distributing system.

ALBANY, N. Y.—Gov. Morton has signed the bill compelling elevated railways to light their cars with gas or electricity.

ST. LOUIS, MO.—Mayor Walbridge has signed the measure providing for placing underground the electric wires in this city.

FOWLERVILLE, MICH.—A contract has been let to Rounsville & Greenway, of Fowlerville, to erect an electric light plant here.

HAMMONTON, N. J.—Plans were submitted to Hammonton Council for the erection of a city water-works and an electric light plant.

KEY WEST, FLA.—Electric equipments will be purchased by the Tropical Electric Company. Address E. H. Martin, superintendent.

CONNERSVILLE, IND.—The Council of this place has been enjoined from buying the electric light plant, on the ground that the city is already in debt far in excess of the legal limit.

ROCHESTER, N. Y.—The Morris County Electric Light Company has purchased a plot of ground east of the railroad tracks from the Youngs estate, and proposes enlarging its plant.

NEWARK, N. J.—The city will establish a plant for the lighting of the Market Building and Plaza. It is figured that the city will save at least $2300 a year by operating its own plant for this service.

COHOES, N. Y.—A broken shaft in the electric light station caused a reign of darkness for two nights, and the services in the Methodist Church on Sunday night had to be dispensed with for this reason.

THREE RIVERS, QUE.—The St. Lawrence River has reached the highest mark on record. The water-works and electric light stations in this place are flooded, and the city is without light and drinking water.

NEWBERRY, S. C.— A meeting of the citizens of Newberry was held April 27, to consider the question of issuing bonds for a system of water-works, sewerage and electric lights. The total cost is estimated at $53,000.

GOUVERNEUR, N. Y.—The Gouverneur Light & Power Company's plant was shut down a few days ago by the flood caused by the overflow of the Oswegatchie River. The town was in darkness for a short time.

LAMBERTVILLE, N. J.—Superintendent W. S. Newton of the Lambertville Electric Light Plant, Lambertville, N. J., in addition to his regular duties, hatches and raises chickens in the boiler-room, the temperature there being always even.

LANSING, MICH.—The report of the municipal electric lighting plant here shows that the cost of operating an incandescent light is ¾ of 1 cent per hour, and that the city makes a profit of ⅛ of 1 cent per hour on each incandescent lamp.

SAN FRANCISCO, CAL.—It is reported that the San Francisco Gas Company and the Electric Light Company, which have been carrying on a war for several months, will consolidate, and a new company will be organized, with a capital of $15,000,000.

TAMPA, FLA.—The Consumers' Electric Light & Railway Company of this city is constructing one of the finest water-power plants in the country, about 10 miles up the Hillsboro River. This plant will supply the company with all the power it requires.

MASSILLON, O.—Yost & Packard, of Columbus, are preparing plans for mprovements to be made at the State Hospital at Massillon. The Legislature has made an appropriation to the amount of $300,000 for the next two years, to be expended in building. A lighting and power plant will be put in.

KENOSHA, WIS.—The Common Council has granted a franchise to Wells, Wheeler & Co., of Beloit, Wis., for an electric lighting plant for the city street lighting, to cost $40,000. The plans under which the franchise is granted is such that the city comes into possession of the plant at the end of five years.

MADISON, WIS.—The controlling interests in the plants of the Madison City Gas, Light & Coke Company, and the Four Lakes Light & Power Company, owned by substantially the same Madison men, has been sold to a syndicate represented by and associated with Emerson & Co., bankers, of New York.

BRUNSWICK, GA.—The Brunswick Light & Water Company has been placed in the hands of the receiver by Judge Spear, at Macon. The assets of the company are estimated at $350.000, and the liabilities at $228,000. The receivership was asked for by the president of the company as a protective measure.

MADISONVILLE, KY.—The *Hustler*, of this place, expresses its satisfaction with the electric light as follows: "The electric light plant for Madisonville is a splendid success in every particular. The lights are fine and from before dark until daylight the streets are lighted up and make the town a pleasant place even in the night time. We all feel proud of our electric light system."

GREAT DAM AT OGDEN, UTAH.—The Pioneer Electric Power Company has awarded to C. Garff the contract for building six miles of six-foot wooden pipe. The contract price is $75,000. The wooden pipe line will lead from the dam site to the mouth of the Ogden Canon, where it will connect with a six-foot steel pipe. Rhodes Bros., of Denver, who have the contract for the excavation and pipe-laying, have 350 men at work, and Contractor Garff will employ 200 more.

THE SOUTH AMERICAN LIGHT, POWER & TRACTION COMPANY, Lima, Peru, has just placed a contract with the General Electric Company, of New York, for the installation of a 5000 horse-power electrical plant. The dynamos will be erected at the water-falls 11 miles from Lima, and the electric power generated will be transmitted to the city, where it will be used to operate the surface railways and electric lights and furnish to the public generally such electric power as may be required. This will be the largest installation of electricity in South America.

TELEGRAPH AND TELEPHONE.

VINTON, IA.—It is stated that the Iowa Union Telephone Company will reconstruct its lines during the present Summer

CHAGRIN FALLS, O.—Kenny & Hill have secured a franchise for the building of a telephone line between this place and Chester.

GREENVILLE, S. C.—A scheme is on foot to organize a new telephone system for the city. George A. Browning is at the head of the enterprise.

MARQUETTE, MICH.—The Marquette County Telephone Company will soon begin the construction of a metallic circuit between Ishpeming and Marquette.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has decided upon some very important extensions and improvements to its State system The improvements will aggregate in cost about $75,000.

OBERLIN, O.—The Oberlin Telegraph Company has decided to run its wire between Oberlin, Elyria, Lorain, North Amherst, South Amherst and Vermillion. Toll stations will be established at the towns mentioned.

LIMA, O.—Notices have been served on all users of independent telephones of this city by the Bell Telephone Company that they are infringing on the rights of the Bell Company, and it looks as if there will be a telephone war in this section.

LOCKPORT, N. Y.—Application has been made to the Common Council of the City of Lockport by the Citizens' Mutual Telephone Company for the privilege of constructing, maintaining and operating a telephone line and lines and exchanges.

SIOUX CITY, IA.—The Western Union Telephone Company will extend its lines south, taking in various places, and will, at Humboldt, form connection with the Iowa Union line, which latter company will also make extensive additions to its system.

PAULDING, O.—The Paulding Telephone Company is now connected with Latty, Haviland and Scott, of this county, also Wapakonetta, Lima, St. Mary's, Celina, Findlay, Defiance, Toledo and the oil fields south, and expects to connect Payne, Antwerp and Briceton soon.

TROY, N. Y.—An ordinance has been introduced in the City Council providing for the building of subways in this city in which the wires of the Troy Telephone & Telegraph Company shall be laid. The ordinance requires that the work shall be completed in three years.

OBERLIN, O.—The $5000 in subscriptions to the stock of the Oberlin Telephone Company, which the directors desired to secure before beginning work, has been made up, and the construction of the line will be begun immediately. It is probable that the exchange will be in operation by July 1.

WILLIAMSPORT, MD.—The system of the Chesapeake & Potomac Telephone Company in Western Maryland will shortly be extended to connect Martinsburg, West Va., with Cumberland. The route for the new line runs through Williamsport to Clear Spring and Hancock, to Cumberland.

EVANSVILLE, IND.—The Dane County Telephone Company is at work on a line to Stoughton and Evansville, and when this is completed it will have connections with Stoughton, Oregon, Brooklyn, McFarland, Cottage Grove and Deerfield. Eventually the company intends to cover every town within 50 miles of Madison.

JACKSON, MICH.—The Detroit Telephone Construction Company has been granted a franchise. Connections will be eventually made between the new telephone company's system in Detroit and the one in Jackson, when they are completed. The prices for telephones in Jackson will be only $24 for business houses and $18 for residences per year.

SELMA, ALA.—The fight between the Alabama Telephone & Construction Company and the Southern Bell Telephone Company has been settled in favor of the Bell interests. The plant and franchise of the former concern was sold to the Southern Bell Telephone Company for the sum of $2500, and the exchange turned over to the purchasers.

DES MOINES, IA.—At a meeting of the City Council a new telephone ordinance was proposed providing for the erection and maintenance of a telephone system in this city, embracing an underground conduit system, with the necessary equipment, and authorizing the maintenance of a telephone system thereir, all previous ordinances inconsistent with this one to be repealed.

SEA ISLE CITY, N. J.—The coast resort towns of Cape May County are soon to be connected with Philadelphia, New York and nearby towns by telephone. A line will be run from Port Morris, on the Delaware Bay Shore, to Cape May. From Cape May the line will run along the coast through Holly Beach, Wildwood, Anglesea, Stone Harbor, Peermont, Avelon, Sea Isle City and Ocean City.

TELEPHONE OUTPUT.—The statement of the instruments issued by the American Bell Telephone Company during the month ended April 20, gives the following figures: Gross output, 21,525; returned, 6330; net output, 15,195. The net output for the same period of 1895 was 12,541, and that for 1894, 2819. The output for April this year is the largest for any one month in the history of the company.

THE ELECTRIC RAILWAY.

WILMINGTON, DEL.—It is stated that a New York syndicate will construct an electric railway from New Castle to Wilmington.

ALBANY, N. Y.—The stockholders of the City Railway Company have decided to increase the capital stock of the company to $70,000.

COLUMBUS, GA.—The Columbus Railway Company has leased the Casino at North Highlands for a term of years, and will use it as a public resort.

FREDERICK, MD.—The Frederick & Middletown Railway Company proposes to build power-houses for the generation of current for its own use.

RICHMOND, VA.—Extensions will be built this season in the system of the Richmond Traction Company. Address W. M. Habliston, superintendent.

NEW HAVEN, CONN.—The New Haven Street Railway Company has completed its extension to Light House Point, and opened a resort at that locality.

ALBANY, N. Y.—The Irondequerk & Lake Shore Electric Railway Company will build a connecting line seven miles long between two summer resorts near Rochester.

JOPLIN, MO.—According to a description in a local newspaper of a recent thunder storm in this place lighting "crawled" along the trolley wire. It also crawled over the electric light wires.

MONROE, MICH.—Gilbert Wickes, of Detroit, has secured the contract for the civil and electrical engineering work required for the construction of the Monroe, Dundee & Lake Erie Railway.

BRIDGEPORT, CONN.—The Bridgeport Traction Company has notified the city that it will not extend its lines unless the old agreement in regard to stone pavements along the tracks is abrogated.

MONTCLAIR, N. J.—At a recent election the candidates favorable to the introduction of the trolley system in this place were elected. The trolley fight has been one of long duration and persistence.

ALBANY, N. Y.—The Watkins & Havana Surface Railway Company has increased its capital stock of $50,000 to $300,000. The company proposes to extend its road 11 miles farther than first contemplated.

EVANSTON, ILL.—The ordinance granting the North Shore Electric Railway Company the right to extend its road from Emerson Street, Evanston, to the Wilmette Village line, was passed at a special meeting of the Evanston Council.

WOONSOCKET, R. I.—The Cumberland Town Council voted to grant a franchise for the Woonsocket Street Railway Company to build and operate an electric railway in the highway from Cumberland Hill to Diamond Hill, leading to Sneach Pond.

NEW YORK, N. Y.—The Staten Island Electric Railway Company has filed a mortgage for $2,000,000, in favor of the Mutual Life Insurance Company. The mortgage covers the entire plant of the company, and the money will be used in extensions of lines.

BROOKLYN, N. Y.—The Long Island Electric Railway Company, it is expected, will open up the Jamaica & Hempstead extensions on July 4 next. The Brooklyn City Railway Company filed a certificate for the extension of its road to the town of Newtown.

HARTFORD, CONN.—It is reported that the New York, New Haven & Hartford Railroad Company proposes to establish an electric system, taking Meriden as the centre. The plans contemplate the equipment of the Waterbury, Meriden & Cromwell line first.

PENSACOLA, FLA.—A company of New York capitalists is seeking a franchise for an electric street railway line. Sterritt Tate is representing them,

and at a recent meeting stated that the company was prepared to begin work at once if the franchise should be granted.

PITTSBURG, PA.—It is stated that plans are on foot for a consolidation of all the street railways in this city, the operation being in charge of a $50,000,000 syndicate headed by Brown Bros., bankers, of New York. Inquiry at the New York office elicited the statement that the story had no basis in fact.

SYRACUSE, N. Y.—The organization plan of the Syracuse Street Railway Company has been declared operative. The time for the deposit of securities without penalty is extended until May 5, after which no further deposits will be received, except on the payment of 1 per cent. penalty on the bonds and ½ per cent. on the stock.

BROOKLYN, N. Y.—It is stated that the Brooklyn Heights Railway Company will make a contract with an express company for the distribution of goods throughout the city. The different car houses along the line will be used as branch express offices and parcels, when called for by wagons, will be taken to them for distribution.

COLUMBUS, O.—The Ohio State Senate has passed the House bill providing for the extension of street railway franchises to 50 years, with an amendment providing that the municipality in which the road is situated, be empowered after 20 years to fix the rate of fare, transfers and percentage to be paid the city, and to renew the privilege again every 15 years.

LEXINGTON, VA —The parties interested in the erection of an electric railway line in Brookland, who were granted permission to do so, will hold a meeting to make arrangements to begin work as soon as possible. The proposed line will run through Brookland to Horseshoe Lake, and it is proposed that the line run to Lexington Court House if it proves successful.

LIGONIER, PA.—The newly chartered electric line, which takes in a number of nearby towns with a branch up the Loyalhanna to this place, will be built next Summer. Col. Hugh Keogh, of Lancaster, is one of the principal stockholders in the new line. All the plans for building have been completed, and work on the main line will be commenced with the opening of Spring.

FOND DU LAC, WIS.—The Fond du Lac Light, Power & Railway Company has been dissolved by the decision of Judge Gilson. The judgment rendered decrees that the company has, by reason of certain acts, forfeited its corporate rights, privileges and franchises, and that it be dissolved and wound up under the direction of a receiver. Gaines A. Knapp was appointed a receiver.

TOLEDO, O.—The Robison street car lines and electric lighting plant property, known as the Toledo Electric Street Railway Company, was sold on April 27 to the New York banking house of Blair & Co. The organization of the new company is as follows: James A. Blair, New York, president; John B. Dennis, vice-president and treasurer; James E. Robison, general manager; Willard Robison, secretary.

MONTREAL, QUE.—Electric railway building on the island of Montreal will be brisk this Summer. Over 30 miles of track are to be laid by the Montreal Park & Island Railway Company. A syndicate has agreed to take that company's bonds and build the road and furnish rolling stock and everything necessary to complete the equipment of the line. The system will comprise seven miles of double track to Lachine, seven miles to St. Laurent, four miles to St. Vincent de Paul, including a bridge over the Back River, to cost $20,000. Mr. Reid is at head of the syndicate.

MONTREAL, QUE.—Messrs. Hooper and Starr, the latter the well-known electrical engineer of Montreal, have commenced work on the construction of an electric railway for freight and passenger service at Cornwall. The contract for the electric apparatus, including a 200-kw generator, 10 G E.-800 motors, has been awarded to the Canadian General Electric Company, The same company will also furnish two closed motor cars of its standard type, the balance of the cars being supplied by the Rathburn Company, of Deseronto. A freight locomotive, on which the motive power will consist of four G. E.-800 motors with special controllers, will handle the freight business between the mills and the Grand Trunk Railway.

STRIKE FELL FLAT.—A strike was ordered on the lines of the Union Traction Company, Philadelphia, on April 30, by the central committee of the Amalgamated Association of Street Railway Employees. According to despatches from Philadelphia the order was generally disregarded, and there was practically no interference with traffic. The only noticeable interruption was on the Fourth and Eighth Street division, where about three fourths of the cars were running, but those which were in operation were manned by the old men. The same was true of 75 per cent. of all the cars which were in motion. The strike was ordered on account of the alleged refusal of President Welsh to submit to arbitration the questions at issue between the men and the company.

Legal Notes.

RAHWAY, N. J.—The Rahway Electric Light & Power Works, the electric railway and all appurtenances were sold by Special Master McMaster, on April 28. The property was bought by W. H. De Forest for $30,000. Mr. De Forest, it is said, bought it for the bondholders of the concern, of whom he is one, and is also interested in property in the vicinity of Sewaren, and is anxious to have the trolley extend in that direction.

JUDGE WOFFORD, in Kansas City, Mo., has decided that the City Council has no power in the matter of fixing telephone charges in the case of the Missouri & Kansas Telephone Company, which was incorporated under the State laws to do an interstate business, and was so doing. Congress alone had the power to regulate the rates. If Kansas City had a telephone system which operated on a franchise from the city, within the corporate limits of the city, the council could regulate its charges, but it could not in the case of this company, who simply had a head office here and whose lines ramified in all directions and to other States.

NEW YORK, N. Y.—The Appellate Division of the Supreme Court, First Department, has handed down a decision denying the application of the Empire City Traction Company for an order directing the Railway Commissioners to issue a certificate to that organization for the purpose of building a railway on certain streets uptown, in New York City. The court holds that the consent of the local authorities in cities containing 1,250,000 inhabitants and over must contain the condition that the right, franchise and privilege to operate a street railway shall be sold at public auction to the bidder which agrees to give the city the largest percentage per annum of the gross receipts of the road. The court further denies the claim of the Empire City Traction Company that it is debarred from bidding at the sale of the desired privilege.

A BILL IN EQUITY has been filed in Philadelphia by James W. M. Newlin, for James Madden *et al.*, minority stockholders in the Penn Company, against the Penn Company and Edison Company, to compel the latter to pay what the court shall determine to be a reasonable rental since 1887 for the Penn Company's conduits. These are alleged in the bill to have been in the exclusive use of the Edison Company during that period at an insufficient rental. The bill is also filed to compel the Edison Company to pay such further sum as has been lost to the stockholders of the Penn Company, by reason of an alleged unlawful combination between the two companies, by reason of the Electric trust being charged to be the owner of the majority of the stock in the Penn Company, and having given the Edison Company the exclusive use of its conduits. This was done in pursuance of an agreement not to compete with each other, and under this agreement it is claimed that the Electric trust has a monopoly of arc lighting, and the Edison Company a monopoly of incandescent lighting and power in the territory covered by the Penn Company's conduits, namely, between Vine and South Streets and the Delaware and Schuykill Rivers. The plaintiffs claim that by these means they get no dividends, and further charge that if the conduits were thrown open to all individuals and corporations desiring to use them, the rentals would enable the Penn Company to pay all its just debts, and also pay dividends on its stock.

Trade and Industrial Notes.

THE ELECTRIC AUTOMATIC APPLIANCE COMPANY, Hartford, Conn., has changed its name to the Monarch Manufacturing Company.

THE E. W. BLISS COMPANY, 17 Adams Street, Brooklyn, has issued its catalogue of cutting and notchings tools for armature discs and sections, presses, drop hammers, shears, dies and special machinery.

THE ELECTRIC APPLIANCE COMPANY, Chicago, general Western agents for the Grutting electric soldering iron and curling iron heaters, is carrying a stock of these goods, which are meeting with ready sale.

THE RUSHMORE DYNAMO WORKS, of Jersey City, N. J., have just issued an illustrated special catalogue of the Rushmore lens mirror projectors and searchlights. This catalogue contains illustrations and prices of their latest types of searchlights.

HELIOS STANDARD ARC LAMPS are described and illustrated in a neat pamphlet just issued by the Helios Electric Company, Philadelphia. Helios lamps are made for both direct and alternating current, and are well and favorably known to the trade.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has recently brought out a pamphlet describing the latest additions to their machine shops, including construction and method of distributing power. The pamphlet is sent to any address on application.

CHARLES A. SCHIEREN & CO., New York, have just completed a large belt for the Knight Electric Light Company, of Springfield, Mass. The belt is 18 feet 10 inches long, 64 inches wide and three-ply thick, and will be on exhibition at the Industrial Building during the Exposition.

THE PHILADELPHIA MACHINE SCREW WORKS, Philadelphia, Pa., are manufacturing all kinds of special machine screws, studs, nuts, etc., in brass and iron, and are making a specialty of manufacturing all kinds of electrical appliances. Their facilities are ample, which fact enables them to fill orders promptly.

THE AMERICAN SILK MANUFACTURING COMPANY, Philadelphia, wishes to call attention to its raw silk machine wipers, recommended and endorsed by the Board of Fire Underwriters in St. Louis and Philadelphia. The testimonials which the company has received seem to bear testimony of the utility of this article.

MESSRS. GRANIS & POILLON, 39 Cortlandt Street, New York, selling agents of the Fleming-Spence Electric Company, will have an exhibit at the Exposition in connection with the Ideal Electric Corporation, which will consist of a full line of their well known alternating-current arc lamps, the demand for which is growing rapidly.

QUIMBY PUMP.—The Quimby screw pump is giving good satisfaction for direct-connected electric work. This pump is compact, efficient and built for long and severe service. It occupies but little floor space, and is operated with the minimum of care and expense for repairs. It is manufactured by William E. Quimby, 59 Liberty Street, New York City.

THE HELIOS ELECTRIC COMPANY, Philadelphia, has just issued a new wiring table, devised by Mr. Hubbard. It is calculated on a 300-volt basis, and will be of considerable service to users of alternating arc lamps, giving as it does the size of wires for distance up to 200 feet, from transformers or economy coils having an ampere delivery up to 100 amperes. The tables are calculated for a loss of 5 per cent.

GEO. H. MORRILL & CO., of Boston, Mass., manufacturers of printers' inks, are erecting a building over some new stills in addition to their already extensive plant. This building will be of steel construction throughout, having steel siding, roof trusses and covering, and the interior platforms will be constructed in the same manner. The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing the complete building.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., in one of its original and unique trade manifestoes, gives some interesting information about and a colored map of Cuba. Through the same medium the company

assures its friends that the strained relations between Cuba and Spain have no effect on the cordial intercourse hitherto existing between itself and its customers, and that it will continue to manufacture bare and insulated wires and cables at the old stand.

THE ZAMOISKI-PALMER ELECTRICAL COMPANY, 208 East Baltimore Street, Baltimore, Md., is a newly established concern. The company does a general electrical supply business, and is contractor for electrical installations. Mr. Joseph M. Zamoiski, the manager, is a well-known electrician, and has been identified with the electrical industry in Baltimore for the past 16 years having been at one time connected with the Warfield Manufacturing Company. The company will make the installation of isolated plants a feature of its business.

IF THE MACHINE TOOL business is to be taken as an example of the tendency of the times, and it generally is, then there is every indication that trade is rapidly improving. The Davis & Egan Machine Tool Company, of Cincinnati, O., state that they are working to their full capacity, and have orders to keep them going for months to come. They report that their business for the past month has exceeded that of any one month for the past several years, and that there is a good prospect of a steady increase. Machine shops all over the country are putting in tools with the anticipation of a brisk Summer and Fall trade.

BOILER TEST.—A test was made on April 14 of the Moyes water-tube boiler at the power station of the Marietta Electric Light, Heat & Power Company, Marietta, Pa., with a view to determining its capacity. Jas. W. Whitman and W. Barnet Le Von, mechanical and consulting engineers of Philadelphia, conducted the test, which shows a possible 10 per cent. excess in economy, with the boiler running nearer its normal rating. The conclusions of the report are that the boiler steams freely and with ease; that the steam is practically dry; the boiler developed with ease 29 per cent. excess capacity above its rating, and with good economy, and that the boiler is well suited to supply steam for a steady pull, and also to responding to sudden fluctuations in the demand.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

"REFRIGERATING MACHINERY," containing the general principles of refrigerating and ice-making machinery, by George Richmond, M. E., mailed free on receipt of 20 cents in stamps. American Engineering Publishing Company, 333 Adams Street, Brooklyn, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 28, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

558,924. MULTIPLE SERIES SYSTEM OF ELECTRICAL DISTRIBUTION; F. B. Badt, Chicago, Ill. App. filed Sept. 25, 1895. In a system of electrical distribution, the combination with translating devices connected in multiple series between main and compensating conductors, of an auxiliary source of electricity, an electrically-operated controlling-switch for connecting said source of electricity in circuit upon one or the other sides of said system, and a relay for automatically controlling the circuit through said controlling switch. (See Illustration.)

558,971. ELECTRIC CONNECTION; J. W. Marsh, Pittsburg, Pa. App. filed May 6, 1895. An electrical connection provided with a protecting covering having mica compound or similar moldable insulating material molded directly to one or both of the members to be connected and forming a tight joint between the parts of the connection.

558,983 CURRENT-STRAIGHTENING COMMUTATOR; C. Pollak, Frankfort-on-the-Main, Germany. App. filed Aug. 28, 1895. In a current-straightening commutator the combination of segments, commutator brushes in sections connected alternately, means for moving a section of each brush toward or away from another section of the same brush and means for simultaneously adjusting all the sections of all the brushes in one direction.

558,989 HANGER FOR ARC LAMPS; L. A. Scovil, Chicago, Ill. App. filed March 28, 1893. In a hanger for an electric lamp, the combination with a guide held in a fixed position of a tube which is adapted to support the lamp adapted to enter said guide, a dog upon said tube adapted to engage with said guide and to support the said tube and means for automatically connecting the lamp into circuit in a predetermined direction.

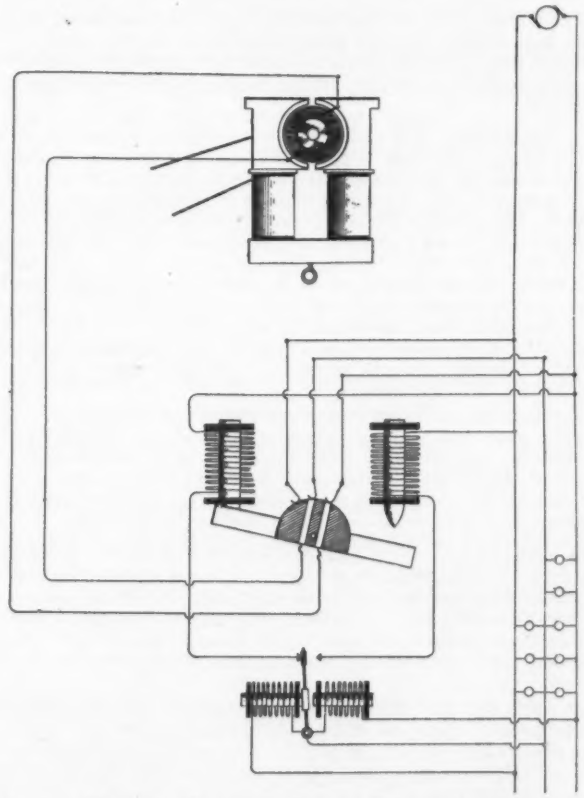
558,993. SAFETY ARC LAMP HANGERS; E. P. Snowden, St. Joseph, Mo. App. filed Feb. 11, 1896. In a hanger for electric lamps a fixedly-supported hanger-box having an open bottom, a switchboard arranged within said hanger-box, a pair of spaced vertically-disposed switch-plug receivers secured to one side of said switchboard and provided at a point intermediate of their ends with laterally-projected binding-posts extending through the switchboard, a switch-lever connection between said plug-receivers, insulator tubes fitted in opposite ends of the box, and having their inner ends disposed directly at one side of the wire-receiving ends of said binding posts, and a vertically-movable lamp-hanger table carrying a pair of switch-plugs having lamp-wire terminal connections therewith and adapted to work in and out of said switch-plug receivers to operate said switch-lever connection.

559,038. AUTOMATIC ELECTRIC INDICATOR SYSTEM; G. E. Painter, Baltimore, Md App. filed Feb. 26, 1895. In an automatic electric signaling system, the combination with a mechanically-driven shaft and a pointer-actuating organization embodying electromagnets, armature levers, and mechanism for operatively coupling said levers with the pointer, of a switch which is connected to and mechanically operated by said shaft, is electrically connected with the indicator and has a main brush arm actuated by an auxiliary arm which carries brush-coupling contacts, is secured to said shaft, and has a restricted movement independently of the main arm whereby, according to the direction in which said shaft may be rotated, the appropriate pointer-actuating magnets will be excited.

559,039. ELECTRICAL SIGNALING APPARATUS; G. E. Painter, Baltimore, Md. App. filed Feb. 16, 1895. In an electric signaling apparatus the combination with an axially-mounted pointer of a vibrative armature lever, provided with a pin or stud at its free end, an electromagnet for vibrating said lever, and a drum or wheel rotatively coupled to said pointer, and provided with a peripheral cam-slot occupied by said pin whereby the movement of said lever in both directions impart an intermitting rotary movement to said pointer.

559,048. ELECTRIC-RUNNING LIGHT AND SIGNAL LANTERN FOR SHIPS; J. Barre, New York, N. Y. App. filed Nov. 29, 1893. A running light for ships provided with a cap at its upper end carrying supports for two or more electric lights, said cap being rotatable with respect to the lamp-fixtures whereby the electric lights may be brought successively into focus.

559,086 TELEPHONE AND CALLING SYSTEM; C. B Smith, New York, N Y. App. filed Nov. 18, 1895. In a telephone system having a plurality of stations a plurality of conductors passing through said stations, each conductor being normally apportioned to one station, telephone instruments in each station, and means in each station arranged to form a closed metallic circuit between the conductor normally apportioned to a station and any one of the conductors that are normally apportioned to the other stations, so that when corresponding connections have been made in any two stations, a closed metallic circuit between said stations, through their telephone instruments, will be established, through the line conductors normally apportioned to said two operating stations.



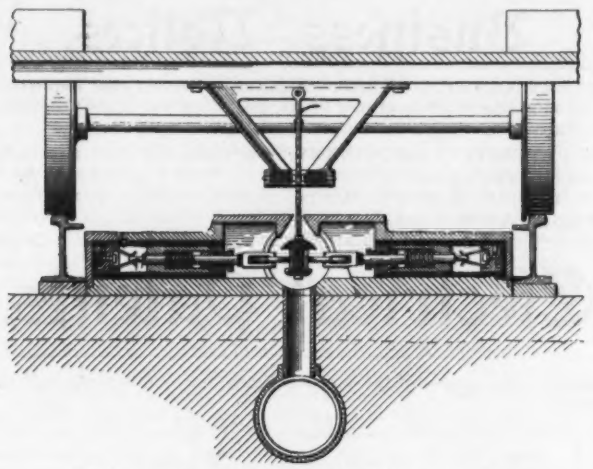
No. 558,924.—MULTIPLE-SERIES SYSTEM OF ELECTRICAL DISTRIBUTION.

559,087. TELEPHONE AND CALLING SYSTEM; C B. Smith, New York, N. Y. App. filed Nov. 19, 1895. In a calling system, a plurality of stations, a plurality of wires passing through said stations, each wire being normally apportioned to one station, calling devices and indicators or annunciators in each station, means in one station for giving a call in another station over the wire belonging to the latter station, and means in the first mentioned station for operating an indicator or annunciator over the wire belonging to the calling station.

559,088. TELEPHONE AND CALLING SYSTEM; C. B. Smith, New York, N. Y. App. filed Feb. 11, 1896. In a telephone system having a plurality of stations, a plurality of wires passing through said stations, each wire being normally apportioned to one station, telephone instruments and calling devices in each station, and electrically-operating devices in each sta-

tion, adapted to be operated from any other station on the system, and arranged to connect the main-line wires normally belonging to two stations through the telephone instruments in a called station.

559,105. ELECTRIC RAILWAY CONDUIT; J. H. Munson, Chicago, Ill. App. filed March 5, 1895. A lateral extension or containing box, of a slotted conduit having a recess or chamber, an insulating-lining therefor, a metallic lining within the same, a plunger slidably within said metallic lining or barrel, and contact and switch devices provided in connection with said plunger, the ends of said recess being closed by water-tight means. (See Illustration.)



No. 559,105.—Electric Railway Conduit.

559,106. TELEPHONE TRANSMITTER; F. A. Ray, Springfield, O. App. filed Oct. 2, 1893. In a telephone transmitter, two diaphragms, comminuted resistance-varying material mounted between and supported directly by said diaphragms, a cell containing said comminuted material, a mouthpiece and air passages communicating with both diaphragms whereby said resistance-varying material is subjected to increased variations of pressure.

559,122. ENDOSCOPIC INSTRUMENT; J. W. Daily, Boston, Mass App. filed Aug. 21, 1895. An endoscopic instrument having a separate or independent tube enclosing therein an incandescent electric lamp and detachably connected to the instrument by means of a slotted plate and set screw.

559,131. SIGNALING APPARATUS FOR PRESSURE GAGES; T. M. Gordon, Boston, Mass. App. filed July 10, 1895. A pressure gage, its pointer, a series of contacts with which it is adapted to co-operate at different pressures, a second series of controlling contacts connected electrically with the gage-contacts, a plurality of normally inoperative signaling-circuits, a high-pressure signal and a low-pressure signal in said circuits and means to include one of the controlling-contacts in each circuit, said means comprising two contact levers, one for the high-pressure signal circuit, and the other for the low-pressure signal circuit, and arranged to reciprocate over said controlling-contacts independently of each other but so as not to pass each other, the gage pointer being in continuous electrical communication with said circuits, whereby variation of pressure will operate one or the other of the signaling circuits.

559,134. MILLIAMPERE METER; C. M. Hollopeter, Fostoria, O. App. filed May 31, 1895. In an electrical measuring instrument, the combination with the upright circular casing of the instrument, of an upright tubular socket, and an L-shaped bracket arm adapted to have its vertical portion turn in said socket and provided at the extremity of its horizontal portion with a reduced portion swiveled centrally in the back of the casing.

559,143. ELECTRIC LIGHT AND SIGNALING DEVICE; D. Misell, New York, N. Y. App. filed Feb. 25, 1896. In a lighting device, the combination of a casing having electrical batteries placed therein, and a lamp secured externally thereto, and conductors connecting said lamp and batteries and a spring-actuated handle, said handle being in operative connection with the said lamp and batteries whereby it is adapted for use as a circuit-maker.

559,155. PROCESS OF HARDENING POSITIVE MASSES OF ACCUMULATORS; C. H. Weise, Poessnick, Germany. App. filed July 13, 1895. The process of hardening the positive plates of storage batteries, consisting in placing the completed lead-superoxide plate into a bath of glycerine.

559,175. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed July 8, 1893. In an electric railway, the combination of a railway track arranged along the roadway, a series of poles located along each side of the roadway and arranged in pairs, one or more series of which poles are made tubular, a suspended conductor or trolley wire arranged at a suitable elevation above the railway track and supported from the upper parts of the poles by transverse suspension wires, a conduit arranged along the roadway, and embedded therein and having branch openings at intervals communicating with the interior of the tubular poles, a supply conductor arranged within the conduit and insulated therefrom, branching conductors connecting the supply conductor at intervals with the suspended trolley wire arranged within the branching portions of the conduit and shielded by the tubular posts, removable caps or covers for the branching points of the conduit, enclosed compartments opening to the street and provided with removable covers for access to said branch points of the conduit and a source of electrical energy respectively connected with the supply conductor and rails.

559,176. MAGNETIZING BOX FOR HAIR PINS; C. A. Dussey, New York, N. Y. App. filed Aug. 22, 1895. A containing case, box or receptacle having a form or support for supporting an article to be magnetized and a magnetized metallic part adapted to magnetize an article supported in the box upon the form.

559,187. ELECTRIC GOVERNOR; K. B. Miller, Washington, D. C. App. filed Feb. 25, 1896. The method of governing the speed of a source of power which consists in generating a periodic current thereby and causing changes in the period of said current to react on the source of supply of power.

559,223. ELECTRIC BOILER; F. W. Schindler-Jenny, Kennelbach, Austria-Hungary. App. filed Oct. 2, 1895. An electric boiler consisting of a ring-shaped heating body of refractory insulating material, containing resistance wires longitudinally extending through the heating body, and a casing in close contact with the said heating body.

559,232. SOCKET FOR INCANDESCENT LAMPS; J. C. Tournier, Schenectady, N. Y. App. filed March 22, 1896. In an incandescent lamp socket, an insulating block, circuit terminals, and a circuit controlling key with a metallic tip and operating spring mounted thereon, in combination with a metallic socket mounted on the insulating-block, the metallic tip of the controlling key being adapted to make contact with the shell and close the circuit.

559,524. ELECTRIC HEEL AND TOE PROTECTOR; J. A. Blair, New York, N. Y. App. filed Feb. 27, 1896. As an improved article of manufacture, an electric heel and toe protector, consisting of the heel socket and the toe socket connected by elastic bands adapted to extend over the arch of the foot and pockets located in said sockets and separately containing electropositive and electronegative elements connected by a conductor.

559,274. ART OF TELEPHONING; D. H. Fitch, Cazenovia, N. Y. App. filed Nov. 29, 1895. The combination of an electromagnet, an auxiliary mechanism actuated thereby, a permanent magnet normally polarizing the electromagnet, and a multiple connection between the electromagnet coils.

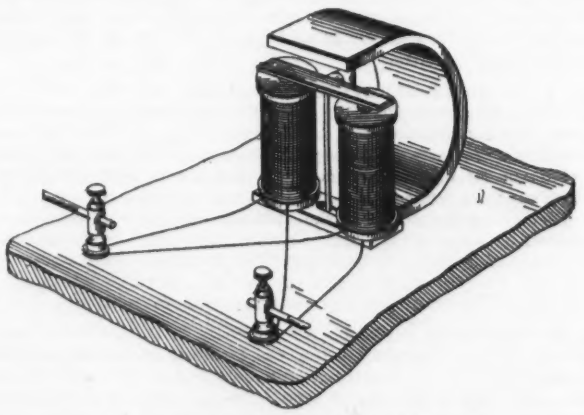
559,275. TROLLEY FOR ELECTRIC CARS; J. L. Foster, Waterbury, Conn. App. filed Sept. 11, 1895. The combination with a pivoted trolley arm or pole and a spring catch pivoted to the rear edge portion of the pivotal part of said arm or pole, of a trigger device having an upper arm adapted when the arm or pole is in contact with the conductor, to take a bearing against the said catch, and springs attached to the lower arm of the said trigger.

559,280. CIRCUIT-BREAKER; M. J. Griffith, Wilkes Barre, Pa. App filed Aug. 28, 1895 .In a circuit-breaker, the combination with two pairs of spring supported and separable contact-pieces arranged in parallel in the same circuit, one pair being provided with terminals of carbon and the other pair having metallic terminals arranged in advance of the aforesaid terminals of a slidable plate of insulating material operating to separate the pairs of contact-pieces suddenly and one after the other.

559,308. CONTROLLING MECHANISM FOR LOCKS; R. A. Palmer, Boston, Mass. App. filed Aug. 14, 1895. A two-part spindle for door locks one member of which is adapted to be operatively connected with the bolt of the lock, a locking device to normally prevent rotation of said member, and means controlled by rotation of the other spindle member to release the locked members and to thereafter move the two members in unison.

559,340. COMBINED SWITCH AND FUSE BLOCK; E. H. Montgomery, St. Paul, Minn. App. filed Oct. 2, 1893. A multiple fuse-block and switch comprising in combination the rotary block of insulating material, the pairs of fuses arranged transversely thereof and of each other, the contacts connected to said fuses, and the sets of circuit terminals in the path of the contacts whereby the pairs of fuses may be successively switched into circuit by the rotation of the block.

559,342. ELECTRIC-TRACTION MOTOR; J. F. Place, Montclair, N. J. App. filed March 16, 1894. The combination with the aerial track and main supply-conductor, the electric-traction motor on the track, a conveyance provided with an electric switch, a two-line and a cable containing conductors connecting the motor with the switch, the same cable and tow-line being connected or tied together, of the couplings in the respective tow-line and cable.



No. 559,274.—Art of Telephoning.

559,348. TELEPHONE SWITCHBOARD; H. M. Fisk, Austin, Ill. App. filed May 27, 1895. The combination in a telephone switchboard of an electromagnet and a drop or a shutter in front of it with connecting or extension points in front of the shutter, and a thin plug attached to a flexible cord and made to lock into the connectors of extension-points.